

CATIA V5 Automotive Extensions Vehicle Architecture — Vision (CV9)

User Guide

BPA Delivery 7 for V5R19 (V5.7)

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 in order to avoid any problems in your work.

Hint symbol



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

Note symbol



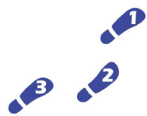
The hand symbol relates to *notes*, which you should pay attention to in order to assure that you can *work without problems*.

Information symbol



The information symbol relates to *Information*, which illustrates a situation.

Work steps symbol



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

Table of Contents

0.	CAVA in General	4
1.	Functionality of CAVA VISION— Overview.....	5
2.	General Input Data for the CAVA VISION Feature	6
2.1	Loadings	7
2.2	Position of the Eye Points	7
2.2.1	Using V5 points as eye points in „Free“ mode.....	8
3.	Rear View Mirror.....	10
4.	Fields of View on the Windscreen	24
5.	Extended and Reduced Fields of View.....	28
6.	A-Pillar Obstruction	34
7.	Reference Points on the Windscreen	40
8.	Vision Cone.....	42
9.	Vision Planes (Free Vision to the Front)	44
10.	Optical Properties of the Windscreen	46
11.	Direct View to the Front / Rear	58
12.	Direct View 3D	63
13.	Close Range Visibility.....	71

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o. 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 OVA, e.g.:

- How CAVA is started?
- How to create and edit CAVA features?
- How to configure CAVA ?
- What is Standard Mode, what is *Free* mode?
- Which parameters can be changed in which mode?
- How measurement in CAVA is executed?
- How to export geometries?

1. Functionality of CAVA VISION— Overview

The CAVA VISION product provides the following tools for the examination of the visibility, concerning the driver's direct und indirect field of view:

Product	Functions	Description see ...
CAVA VISION		
	 <ul style="list-style-type: none"> • Rear-view mirror 	– section 3 from page 10
	 <ul style="list-style-type: none"> • Fields of view on the windscreen 	– section 4 from page 24
	 <ul style="list-style-type: none"> • Extended/Reduced fields of view 	– section 5 from page 28
	 <ul style="list-style-type: none"> • A-pillar obstruction 	– section 6 from page 34
	 <ul style="list-style-type: none"> • Reference points on the windscreen 	– section 7 from page 40
	 <ul style="list-style-type: none"> • Vision cone 	– section 8 from page 42
	 <ul style="list-style-type: none"> • Vision planes (free vision to the front) 	– section 9 from page 44
	 <ul style="list-style-type: none"> • Optical properties of the windscreen: <ul style="list-style-type: none"> – Optical distortion – Double Image 	– section 10 from page 46
	 <ul style="list-style-type: none"> • Direct view to the front / rear 	– section 11 from page 58
	 <ul style="list-style-type: none"> • Direct view 3D 	– section 12 from page 63
	 <ul style="list-style-type: none"> • Close range visibility 	– section 13 from page 71

2. General Input Data for the CAVA VISION Feature



Definitions

① BaseData

Base data on which this feature is based. (see OVA Manual—Base data section). After selecting the base data, the target data respective to the vehicle category is activated.

② 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. (e.g. for the *Fields of View* feature in *FieldOfView.xml*).

By selecting *Free* you can avoid the defaults and define your own settings for specific values. The *Free* mode is available for most features of the View Product.



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

③ Loading

• Deactivated state:

The default is defined by the standard, defined in the configuration file.

• Activated state (only in *Free* mode):

The list contains all loadings that have been activated in the *BaseData* dialog box under “*Loadings*”—“*Preconfigured Loadings*” and “*User-defined Loadings*” (see CAVA OVA Manual).

④ Free mode

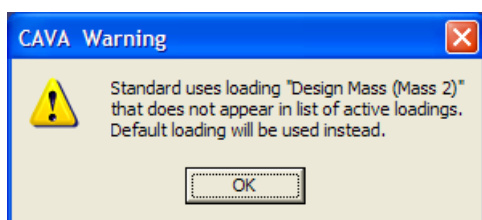
Some of the View features offer the optional possibility to define free values in addition to the fixed defined values.

⑤ Eye

Opens the specific dialog box for the current eye points and eye ellipses. (See next but one paragraph).

2.1 Loadings

In the configuration file for each CAVA function, a specific loading is defined for each default. In case this list of available loadings is not active or missing, you will receive a warning that the *Default* loading is used instead of the designated loading.



2.2 Position of the Eye Points

Except for the function named "Optical properties of the windscreen", all functions of the VISION Product need a defined position of the eye points. Said position is defined in the standards, either directly by the points or by the eye ellipses according to SAE Standard.

The various standards for the location of these elements are represented in the CAVA functions "Eye points" and "Eye ellipses" of the *Manikin* Module.

In the configuration files of the CAVA *Vision* features one of each eye definition is referenced respectively. The correct selection of the eye points is thus not in the hands of the user, but predefined by the configuration. The corresponding loading is the one defined for the vision standard and not the one stated in the Manikin configuration.



If e.g. a vision standard refers to the loading „Empty weight ML1“ and the eye points according to „EWG/ECE“, this means that also the eye points for this vision feature are calculated with the „Empty weight ML1“ loading, independent from what is defined in the Manikin configuration.

2.2.1 Using V5 points as eye points in „Free“ mode

To check the visibility independently from the standards you have the possibility to use free defined V5 points as eye points in the “Free” mode.

This could be an interesting option for the rear mirror view investigation to check the comfort and settings for persons with different body size, independently from the standards.

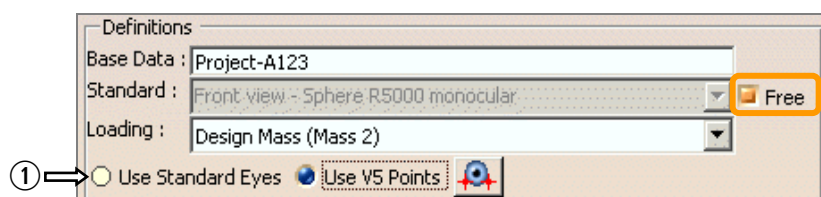
To use the free defined eye points you have to select a general European standard that uses the so called P-, V-.or O-points

The type (P, V or O) that is used as eye point is internally given by the CAVA function. Accordingly, the selected V5 points are assigned to respective eye point types.



If a standard is using the eye ellipses (e.g. FMVSS or ADR Standard) and you are switching to “Free” mode the free selection of eye points will not be enabled.

Analogue behavior for the „Extended Eye points“ for the close range visibility (Japanese MLIT Standard)



① Eye point definition (only enabled in „Free“ mode)

Here you can select the eye points that should be used for the calculation.

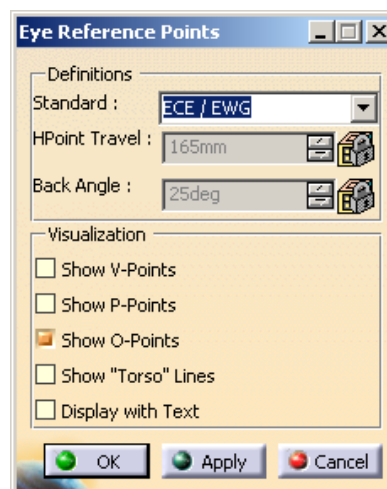
The default selection is „*Use Standard Eye*“. With this option the eye points are calculated internally by CAVA.

The „O-Points“ are used as eye point type, i.e. the eye points are analogue to the EU Standards for the rear view mirror (653 mm above the SgRP, and 32,5 mm in both positive and negative y -direction).



Click on the eye point icon.

A dialog box for the eye point settings will open.

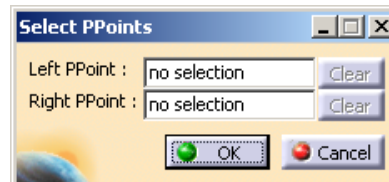
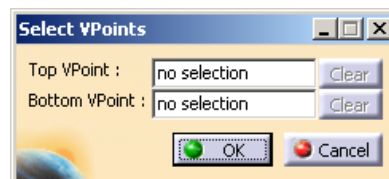


In the „Free“ mode you can select the option „Use V5 points“ to define any V5 point as eye point (P-point). Click on the eye point icon.



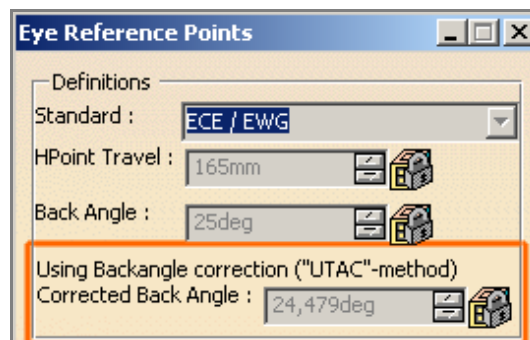
Click on the eye point icon.

A dialog box will open. In the fields „Left PPoint“ and „Right PPoint“ or „Top VPoint“ and „Bottom VPoint“ (depending on the used CAVA function) you can assign the according eye points by selecting the respective V5 points in the model.



The selected eye points are associatively linked to the CAVA Feature. A modification of the linked V5 points will lead to an update of the CAVA calculation.

If the eye point calculation is set to use the UTAC method (see CAVA manual „General“) you can check up the method used for the eye point calculation by clicking on the eye point icon in the respective CAVA feature dialog box.



3. Rear View Mirror



The CAVA Mirror function shows the fields of vision through the rear-view mirror, including possible obstructions within V5. On one hand this enables the check for the homologation and on the other hand you can easily check the influence of the various mirror parameters on the field of view.

The range of vision is represented in two different ways simultaneously:

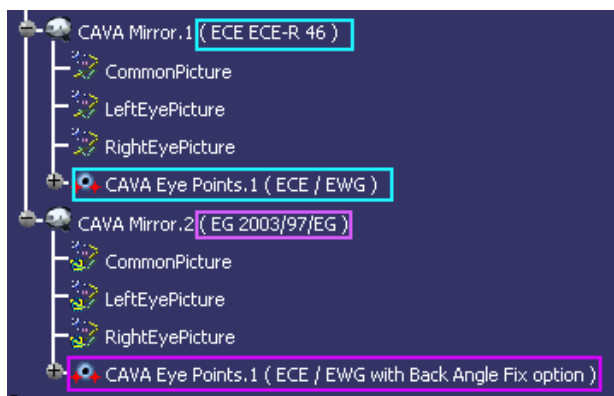
- Representation of the mirror's contour and possible obstructing elements on the road surface, or respectively a plane that is normal to the road surface (measuring plane).
- Representation of the regulation fields defined in the standards and of possible obstructing elements on the mirror surface.

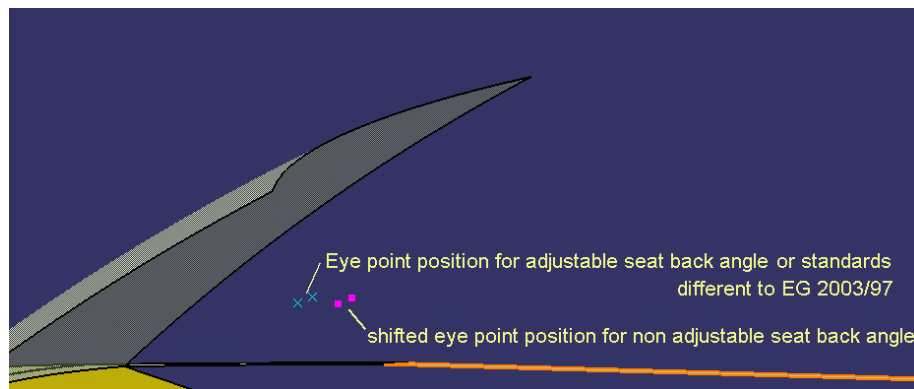
Both representations include both eyes, since vision with both eyes is decisive for the verification of the standards.



Since BPA Delivery 7 CAVA is considering the correction (shift) of the eye point position for the regulation EG EWG 2003/97, if the seat back angle is defined as 'fixed' (non adjustable) in the CAVA *Base Data* feature.

Back Angle : 25deg HPoint Travel : 165mm





Definition of the mirror area

The first step is to define the mirror face and position. The mirror feature offers a variety of plate glasses: planar, spherical and aspherical ones. In addition there is the possibility to define a free surface as face.

Depending on the chosen type, it may be necessary to enter additional parameters.

Along with the complexity of plate glass it is necessary to define the position. This is done with the help of a rotation point, the distance of the face to the rotation point and two angles.



The angles refer to the fixed z axis and the rotating y axis.

In case there is already a mirror contour as a V5 curve within the V5 document, such a contour can be selected. On the measuring plane (e.g. the road surface) the image of the contour for the left and the right eye is shown in this case.

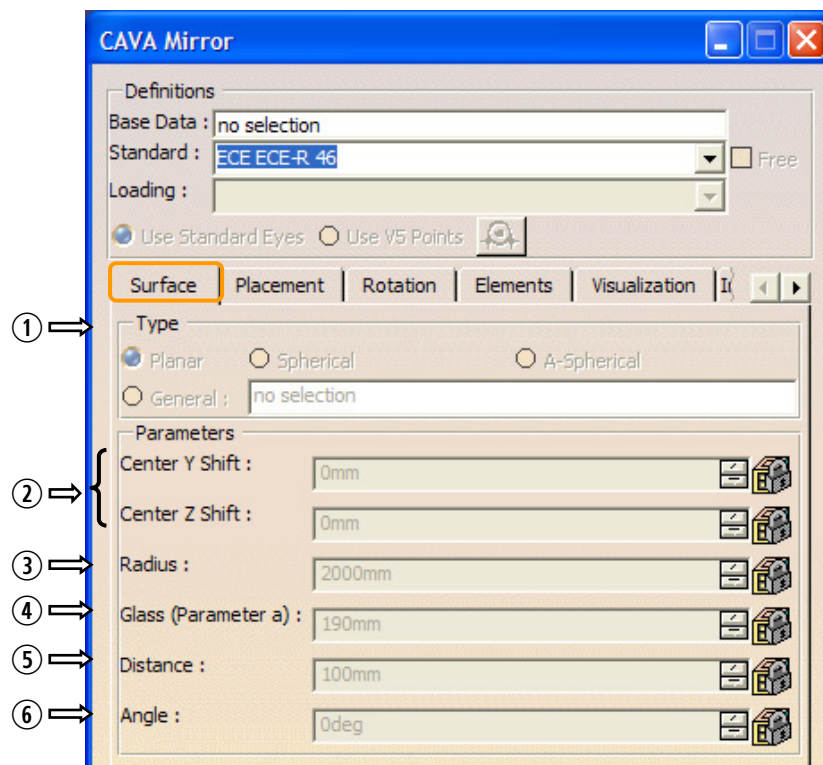


The selected contour must be a closed planar V5 curve. In case it is not located on the mirror surface, e.g. with a spherical mirror and a planar curve, it is projected onto the plane internally.

However, the mirror feature can also be used, if there is no contour yet. Images of the regulation fields or other geometries on the mirror surface can then be used to design the optimal contour.

The distance to the rotation points is automatically calculated by the program if a V5 curve is selected as mirror contour. In this case the value cannot be edited. It is however possible to work without defining a contour.

- **Mirror dialog box**



- **Surface tab card**

- ① Type of plate glass

There is a choice between planar, spherical and aspherical plate glass. In addition you can select any face if the „General“ option is active.

When using the “General” option without selecting a contour, as contour internally will be used the boundary of the general surface.

- ② Center y/z Shift:

For spherical and aspherical mirrors the center point of the sphere surface lies generally on the extension of the normal point of the rotation point and the rotation point. In some cases, e.g. with commercial vehicles, in practice a small translation of the center point is used. These two values describe this translation in the y and z directions (mirror in o.o-position, i.e. net parallel).

- ③ Radius

A radius for spherical and aspherical mirrors is defined here.

④ Glass parameter (Parameter a):

A glass parameter has to be defined for aspherical mirrors. It has an influence on the shape of the aspherical part of the mirror and is provided by the glass producer. A typical value is 190 mm.

⑤ Distance of the aspherical part from the center point:

Definition of the distance of the transition to the aspherical part from the center point of the mirror (normal point of the rotation point).

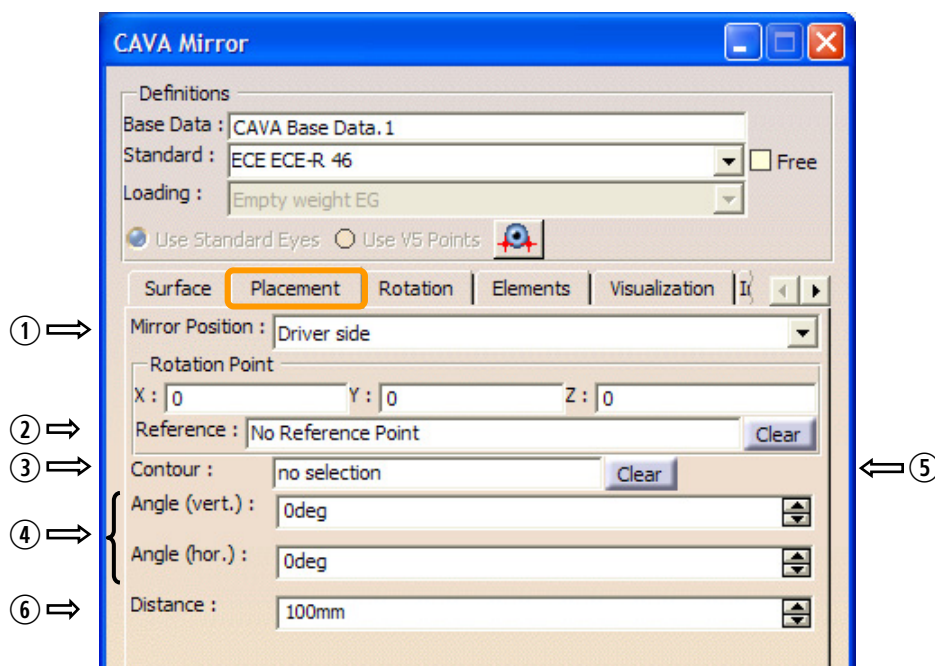
⑥ Angle

Angle of a tangent to the aspherical border line to the vertical plane.



The glass parameter is part of the equation for the aspherical part. The equation defines a planar curve, which is rotated around a rotation axis and thus represents the aspherical surface. The glass parameter defines the distance of the rotation axis to the aspherical part within the production process.

- **Placement** tab card



① Mirror Position

Various positions can be defined in the configuration (as identifier). An instruction field can be defined for each of these positions. The user can select which mirror he wants to test/design.

② *Rotation Point* reference field

The definition of the mirror rotation point is significant for later adjustment of the mirror. Under 'Reference' you can select a V5 point; the coordinates define a possible translation to this point (analog with a point definition in V5).

③ *Contour*

If available, the contour of the mirror can be selected here by a closed planar curve.

④ *Angle of the mounting position (Angle):*

Definition of the mounting position in two angles (fixed z axis and rotating y -axis). When selecting a contour, both angles are calculated with respect to the position of the contour and cannot be edited. With all later settings the difference to the mounting position is stated.

If you have selected a general surface and no contour is selected, you can set the initial position of the surface by defining values for the horizontal and vertical angle.

If you have selected a contour these fields will be automatically calculated and are not editable for the user.

⑤ *Clear* button

By pressing this button the selected reference is deleted.

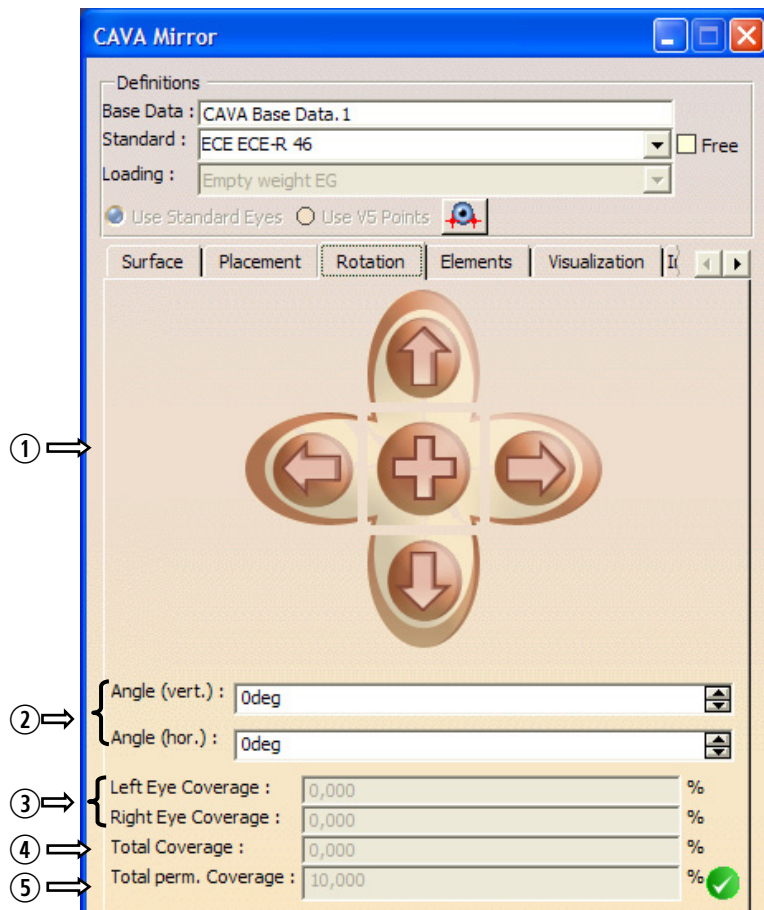
⑥ *Distance Rotation point—Mirror surface (Distance):*

Defines the distance between the rotation point and the mirror surface. It is calculated when selecting a contour and cannot be edited.

If you have selected a general surface and no contour is selected this field will disappear.

• Adjusting the mirror (Rotation)

After the definition of the mirror and its position, the mirror can be dynamically adjusted at any time.



① Dynamic adjustment of the mirror

The mirror can be adjusted dynamically with the help of the arrow keys. The direction of the rotation corresponds to the view of the driver, i.e. the arrow keys correspond to the electric switches in the vehicle. The plus symbol in the center resets the mirror to its mounting position. The adjustment happens in the angle steps described as steps in the angle fields, normally 1 degree. Modification by right mouse click.

② Current setting with regard to the mounting position (Angle)

States the current position of the mirror with respect to the mounting position. I.e. this value also serves as a test, whether or not the actuation of the mirror is dimensioned sufficiently.

③ Left / Right Eye Coverage

Shows the current percentage of coverage of the instruction field for each eye.

④ Total Coverage

States the current total coverage of the instruction field, i.e. the value, which is crucial for homologation. Normally this is not the maximum coverage per eye.

⑤ Total Perm Coverage

States the required total coverage of the instruction field, i.e. the value, which is crucial for homologation. This value is defined in the configuration file of the mirror feature (Mirror.xml, tag name: 'ReqTotalCoverage').



Remark: Not all standards contain a total required coverage for the instruction field. So in some cases the value does not appear in the dialog box.

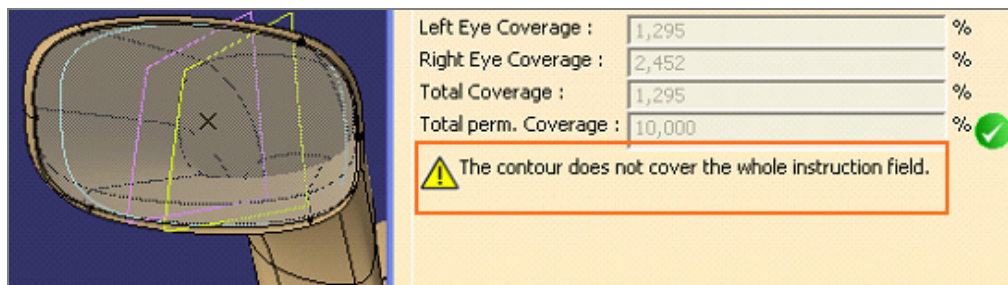


As long as the current total coverage does not exceed the total permitted (required) coverage the „OK“-Symbol is displayed behind the value.

If no covering vehicle geometry is selected (see tab card „Elements“) the calculated total coverage describes the visibility of the instruction field on the mirror glass.

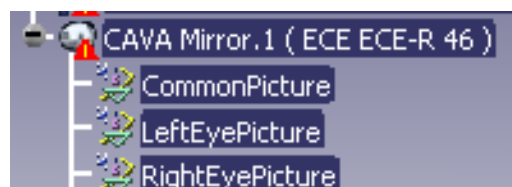
For instance, a total coverage of 5,35 % means in this case that 94,65 % of the instruction field is visible on the mirror surfaces.

The rules say that the complete instruction field has to be covered by the mirror glass contour. Therefore a warning message will appear below the fields of the calculated coverage if the instruction field is not completely covered by the mirror glass contour in the current position (see fig. below).



If the total permitted (required) coverage is exceeded the “Error” symbol will be displayed right behind the value.

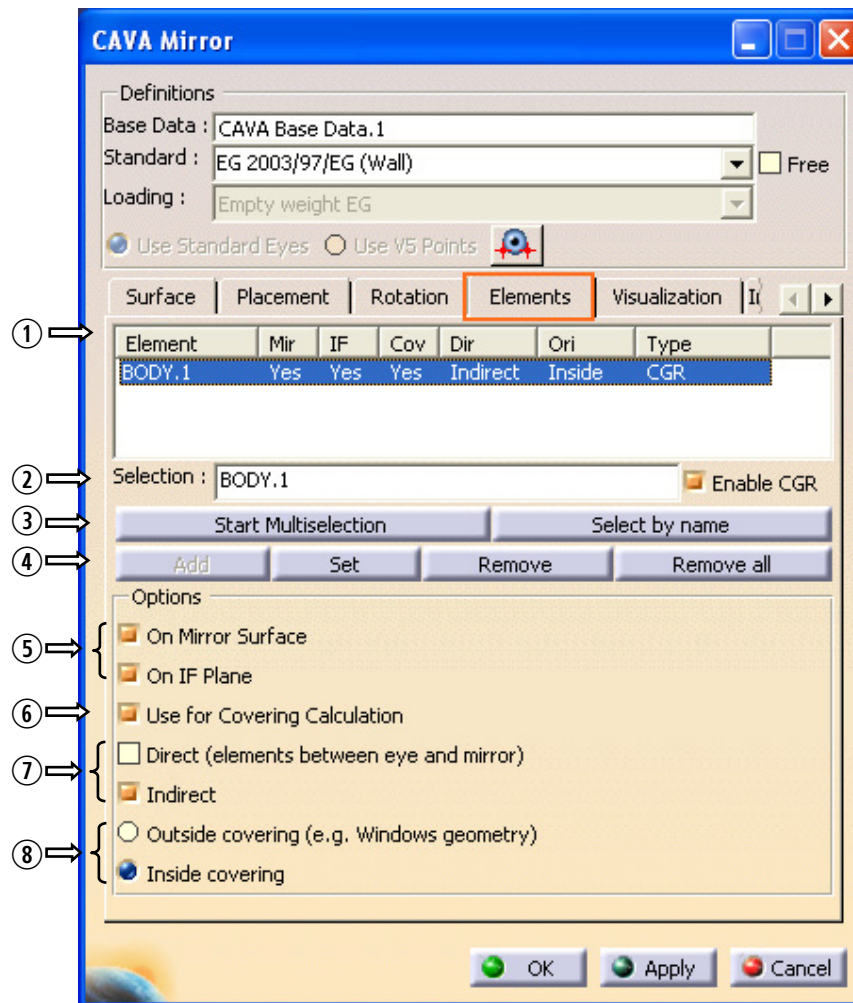
In the specification tree the symbol is also displayed behind the icon of the mirror feature



With an instruction field defined on the road surface, the field is limited at the value defined as infinite. This means that only this area is considered in the calculation of the obstruction.

• Selection of obstructing elements

Here you can define V5 elements, which add to a possible obstruction, at any time, and the visibility of which is meant to be tested in the mirror. This can e.g. be vehicle sections or surfaces, with respect to obstruction, or the point of an overtaking vehicle, in order to test whether or not it is visible.



① List of selected elements

This list includes all elements selected so far and with their parameters.

② Selection

Select to highlight this field and select a geometry element from the model that you want to add to the list of covering vehicle geometry.

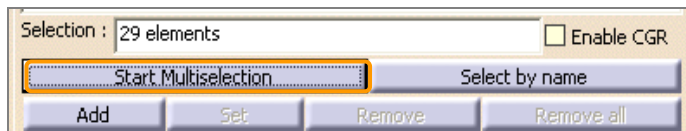
If the option *Enable CGR* is active, CGR files can be selected. They are calculated with the help of their tessellation.

If you want to select more than one element at once you have to use the button

“Multiselection” or “Select by name”.

Take note that you have set the options (option frame) for the element before you add it to the list.

③ Multi-selection of geometry



Use the *Start Multi-selection* button to select more than one geometry element at once.

You can find a detailed description of this functionality in the manual “General” in chapter „CAVA Measurement/Geometry selection“.

After finishing the multi selection you will have the number of selected elements in the geometry selection field ②.

Click on the “Add” button to commit the selection to the list.

If you want to assign the same settings for all selected elements you can make the settings in the option frame before you add them to the list.

List control buttons

- Add:

Click on the button „Add“ to add the geometry element that is currently in the geometry selection field to the list. Take note that you have set the options for the element before you add it to the list.

- Delete:

Mark the element(s) you want to delete in the list and use the button „Remove” or “Remove All” to remove them from the list.

- Edit:

If you want to change some settings of an element that is already in the list, you have to mark it (select to highlight it) in the list and make the changes and commit the changes back to the list by using the „Set” button.

Options

⑤ Element should be considered for the following representation (On Mirror Surface / On IF Plane):

Stating whether the selected Element for the representation on the mirror surface or respectively the instruction field (IF = Instruction field) should be considered.

⑥ Use for Coverage Calculation

If this button is selected, the following selected elements are considered for the calculation of the obstruction.

⑦ Directly / Indirectly obstructing elements (Direct / Indirect)

An element situated between the eye of the driver and the mirror is a directly obstructing element. An element situated within the course of rays behind the mirror is an indirectly obstructing element. It has to be stated for each individual element, if it is a direct or indirect element, e.g. part of the mirror housing can be either directly or indirectly obstructing.

⑧ Inside / Outside obstruction

A selected element can either be obstructing inside or outside, e.g. the border strip of the rear window pane is outside obstructing, since the rays are only visible when they run through the center of the curve. On the other hand for e.g. the contours of a head rest are inside obstructing.



If curves are selected as obstructing elements, they are always (in the case of open curves) closed through their end points. This guarantees that they can be used for the obstruction calculation (inside / outside).



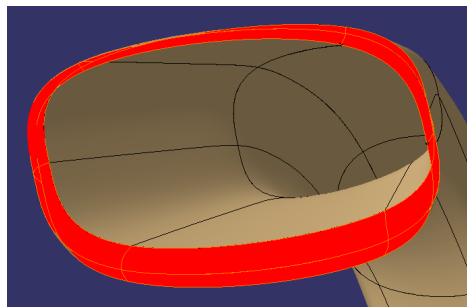
Planes and their borders are considered from the individual view direction. Thus the results are approximated with the help of the corresponding plane tessellation, in order to keep calculation times short.



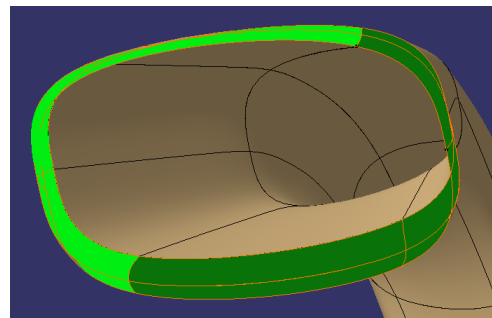
Remark for the selection of the mirror housing:

Because of the surface tessellation it could happen that the selected surface with the opening for the mirror glass is interpreted as a "hole". These holes can yet not be considered by the tessellation algorithm because the internally used triangles do not have the necessary topological information. Therefore it is advisable to split the surface into two separate ones (see figure below).

Remark: A selection of the whole mirror housing will not solve the problem because it is internally cut behind the mirror glass and as result there will still be a "hole".



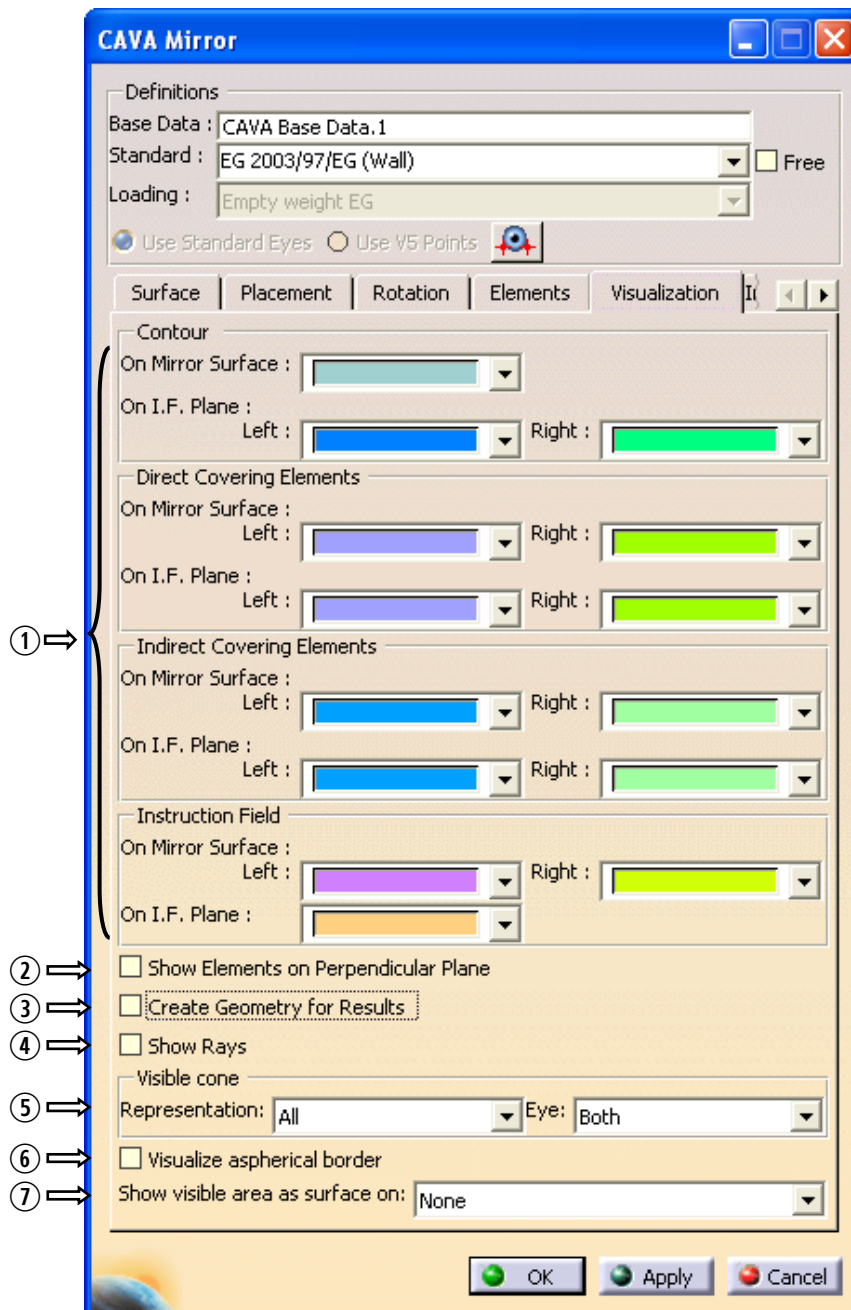
Problem: Closed Surface => "Hole"



Solution: 2 surfaces, no „hole“

Visualization Options tab card

You can avail of various options for the visualization of the results; specifically you can define the various elements in different colors.



① Color range

A number of different colors can be defined for the various elements, in order to distinguish them better in the part.

② Show Elements on perpendicular plane

If the instruction field is located on the road surface, it is normally of great interest to show how far the contour covers the area above the road surface. If this button is active, the results are additionally shown on a plane (at the maximum x value of the field).

③ Create Geometry for Results on I.F. plane

If this button is selected, the results on the road surface and the optionally activated vision rays within the mirror feature are created as geometries. If the button is not activated, they are shown as individual visualizations.

A geometrical representation is a precondition for generative drafting.

④ Show Rays

If this button is activated, an additional four rays from the mirror to the measuring plane are shown. These are approximately the four "extreme" rays, i.e. the innermost, the outermost, the top and the bottom ray.

⑤ Visible Cone

The visible cone describes a surface, representing the limits of the field of view starting from the contour.

The sight rays to all contour points are created and the space between 2 neighbored lines are filled with surfaced representation.

The representation of the visible cone is limited by the instruction field on the wall or by the distance that is defined for „Infinite Limit“ in tab card „Instruction Field“.

View covering elements will not be considered.

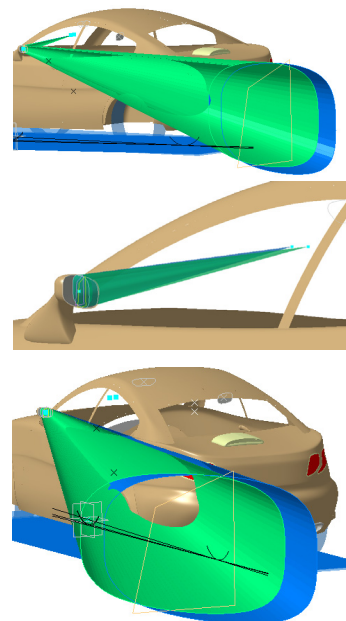
In the Representation selection list you can choose different sight lines:

No Visible cone is not displayed.

ALL The sight rays start at the eye points, run then to the mirror contour and from the contour back to the road or wall.

Eye to contour The sight rays start at the eye points and end on the mirror contour.

Contour to Target The way of the sight rays start at the mirror contour and end on the road or wall.

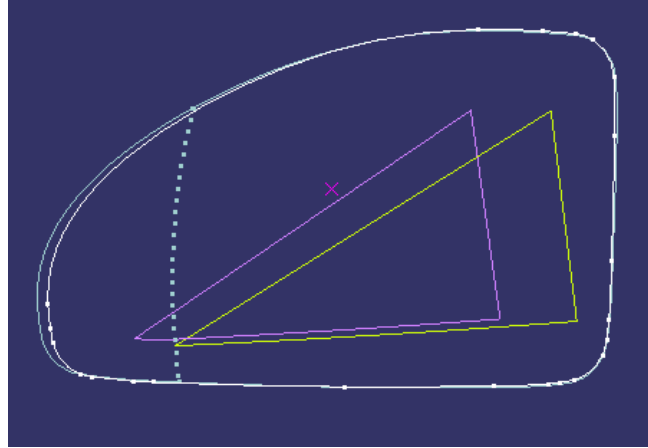


Eye

The visible cone can be visualized separate for the left or right eye but also for both eyes together. Select the corresponding option from the list.

⑥ Visualize Aspherical Border

This option visualizes the border of the aspherical area.



⑦ Show visible area as surface on

It is possible to create the visible area as surface in the model. There are different options for it:

- None The visible area is not generated as surface in the model.
- IF (*Instruction Field*) The visible area is generated as surface on the instruction field in the model.
- All The whole visible area is generated as surface on the instruction field that is seen in the defined mirror.

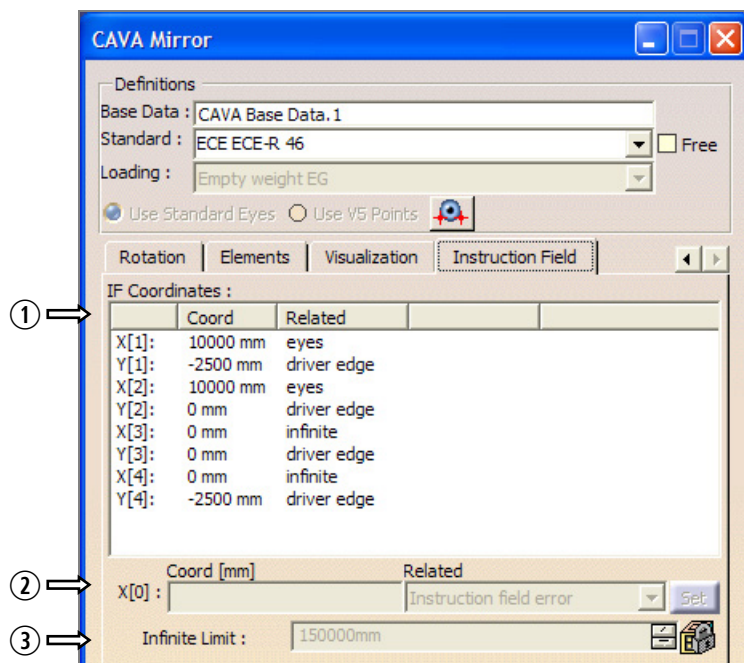


If the fields of view should be visible on the road surface and/or the rays in a V5 generative drafting, it is necessary to activate the 'Show results as geometry' button.

• Definition of the instruction field

An instruction field for each mirror position is defined in the configuration file. This is done with the help of various key words and relations. The current standards can be presented either on the road surface or on a perpendicular plane. All fields are specified by corner points, with an arbitrary number of points. Each point can refer to a different vehicle mass, e.g. a reference can be created to the outermost or hindmost point of the vehicle or to the eye points.

The defined fields can not be edited in the interactive application.



① Instruction field

Points defining the current instruction field.

② Coordinates

In *Free* mode you can change values here. Therefore you have to select an element from the list that will be put to the field. Now, you can change the value and give it back to the list using the *Add* button.

③ Actual value for infinity

The value used for infinity is stated in the configuration file. It is used for the representation in 3D (expansion of the field), as well as for the calculation of the obstruction percentage.



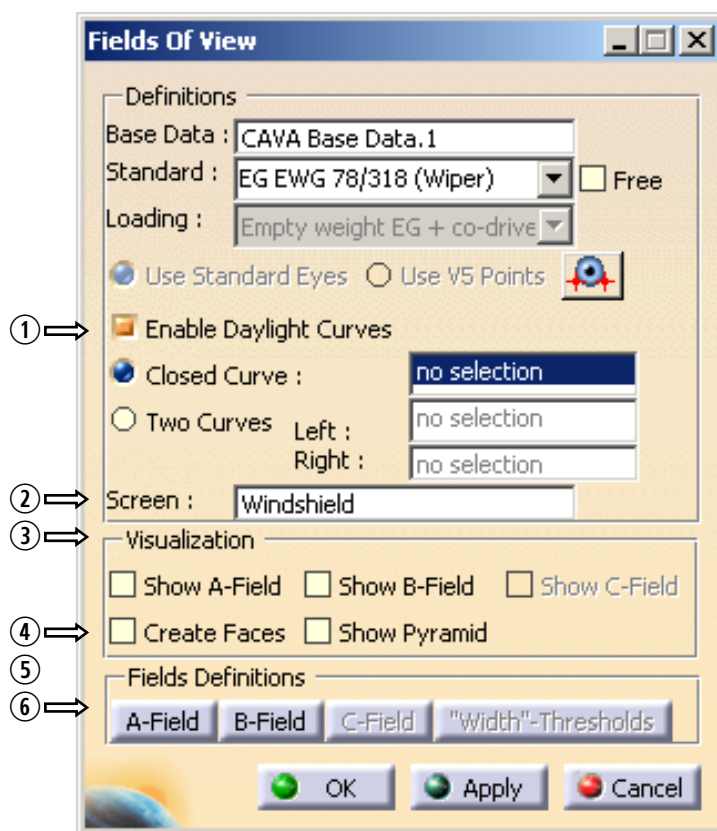
If in one of the fields under *Related* the statement is „Error“, this means that the definition of the field is incorrect in the configuration, e.g. a wrong key word has been used.

4. Fields of View on the Windscreen



The fields of view on the windscreen define various areas on the screen, which are relevant for the following studies. These A-, B- and C-Fields (C with FMVSS and ADR Standards) are necessary e.g. when the wiped area is checked, when the pane is de-iced or with regard to the properties of the windscreen.

- *Fields of View* dialog box



① Daylight opening Curve (optional)

If no curve is selected in this field the offset, if applied, will be generated from the boundary of the selected surface.

Usually, the surface is the complete windshield including the black dotted area at the boundary. But this area is not included in the offset of 25 mm. By selecting a curve representing the daylight opening the offset, if applied, will be generated from the boundary of the selected curve.

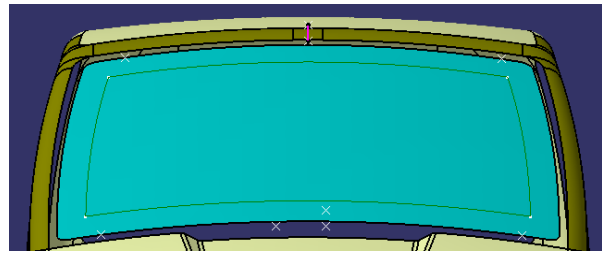
② Screen

V5 face of the windscreen on which the fields of view are calculated. The face is linked

associatively with the feature, i.e. the CAVA feature reacts to changes on the face. The entry can be omitted, if only the „Show Pyramid” planes are shown.

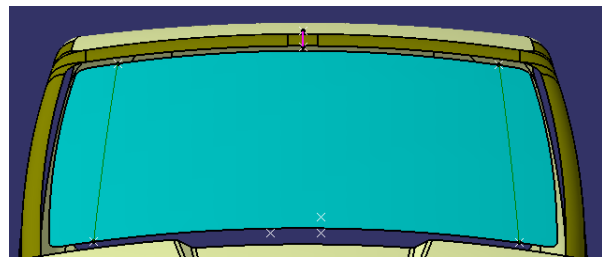
- Closed Curve

There is an existing closed curve (see Fig.) for the *Daylight Opening*.



- Two Curves (left/right)

The *Daylight Opening* is defined by two boundary curves (see fig.). Select the appropriate curve for the left and right side.



③ Visualization

Select which fields are to be visualized in the model.

④ Create Faces

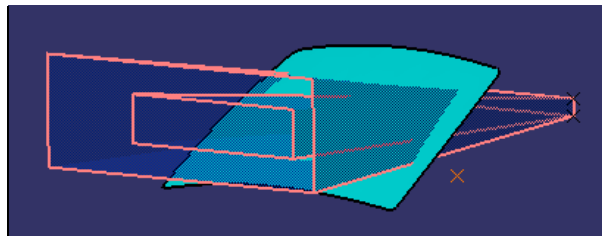
If this button is activated, the fields are created as faces within the feature. If the button is not activated, they are shown as curves. It is required that a face is selected as a screen.



This button should be activated if the fields are to be used as face elements, e.g. for the use of the CAVA function „Optical properties of the windscreen“

⑤ Show Pyramid

If this button is activated, the confining faces (4 per field) are shown as planar faces. In this case a selection of the screen is not necessary.



⑥ Field definitions (A, B, C-Fields)

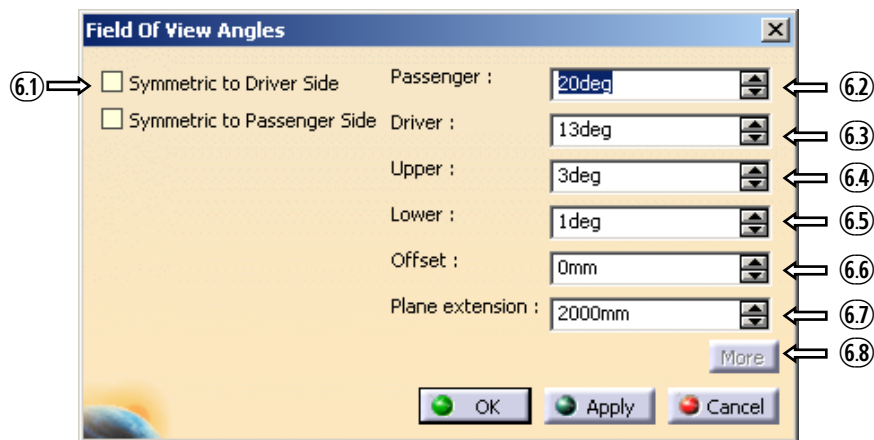
Here you can see the current settings for the fields in a separate window, or respectively edit them in the „Free“ Mode.

Corresponding to the definition in the configuration a default can contain a maximum of 3 fields. These are described as A-, B- and C-fields. Fields of which the related buttons are not available for selection are not defined for the selected default

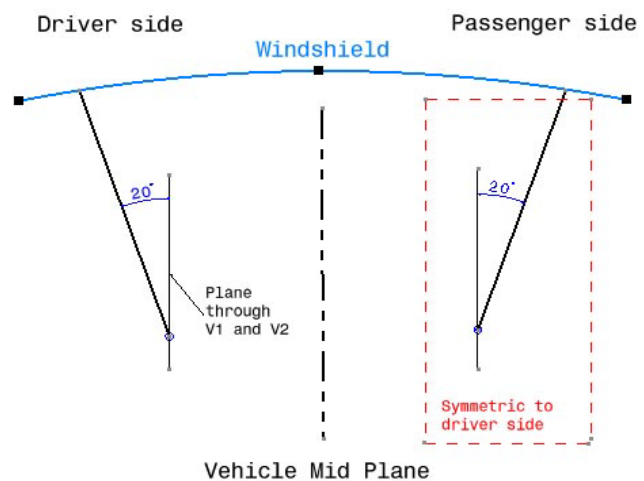
Width Thresholds

Width thresholds are of special interest to the American and Australian standards. In their case the angles of the planes depend on the width of the vehicle.

Example for the A-Field (European Standard)



- 6.1 In order to cover the European standards, one of the horizontal angles (driver or passenger side) can be defined as symmetric. As a result the respective plane and the other plane will be situated symmetrically to each other relative to the vehicle centerline (see fig. on the right).



6.1-6.5 Parameters for the Fields of View

The fields of view are defined by four planes, which are attached to the eye elements at a certain angle. In the case of the European standards these are the V1 or respectively V2 points. If the defined eye elements for the fields of view are eye ellipses, the planes are attached to these ellipses tangentially at the defined angles.

6.6 Optional Offset Value

Some standards define a minimal distance of the fields of view to the outer frame of the windscreen. This can be achieved by using the Offset parameter in the configuration or in the *Free* mode. An offset curve with respect to the frame will be calculated internally and the fields will be trimmed accordingly.

6.7 Plane Extension

If you have selected the option *Show Pyramid* you could control the extension of the planes by the field's value.

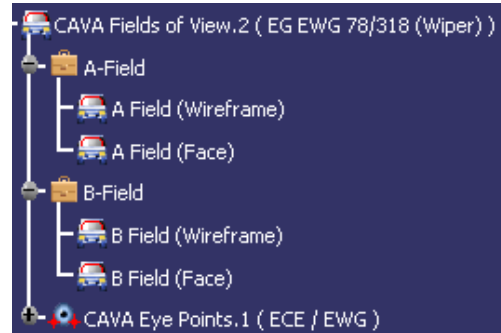
⑥.8 Optional definition of the angles depending on vehicle width

In the configuration of the standard you can define various intervals of vehicle width (up to 4 intervals). For each of these intervals you can define different angles in order to show the American or Australian standards. This means that varying angle values are used for the calculation of the fields, depending on the vehicle width selected in the base data feature.

Specification tree entries

The geometry type may change between surface and wire depending on the feature dialog settings.

The Fields of View feature has a bag for each of the fields (A-, B- and /or C-filed) and its currently activated geometry items (wireframe, surface, and pyramid).



The use of an offset value increases calculation time substantially as the internal offset curve on the screen has to be calculated.



The standards leave a certain room for interpretation regarding the question, in how far the black coloring of the pane has to be considered with regard to the minimum distance to the border (offset value). This fact has not been specially accounted for within CAVA and depends on what the user selects as windscreen. (See option “Daylight opening Curve (optional)” above)



In an early phase of the vehicle concept, when the windscreen is not present as geometry yet, the user can select the Show Pyramid option. In this case the confining faces are shown and a specification of the screen is not necessary.

5. Extended and Reduced Fields of View

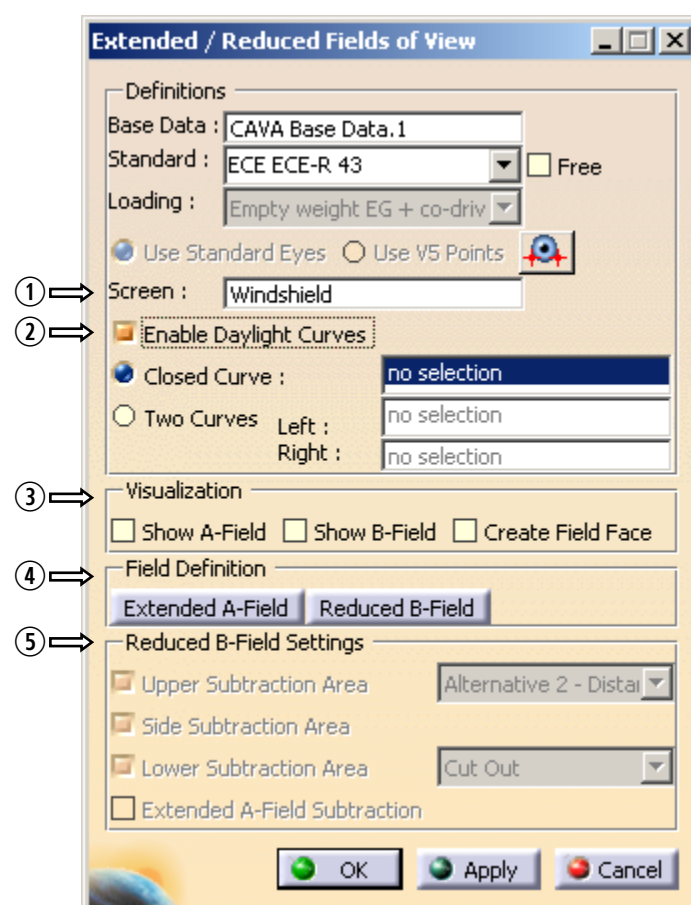


The standard ECE-R 43 defines an extended A-Field and a reduced B-Field.

Given that the vision points on the windshield have to be always in the visible area, there are different interpretations of how to define the reduced B field in practice.

Thus, CAVA offers the user on the GUI alternative ways to define the reduced B-field.

- *Extended and reduced fields of view* dialog box



① Screen

V5 surface of the windshield on which the extended/reduced fields of view are calculated. The surface is associatively linked to the CAVA-Feature, this means that the CAVA-Feature is taking into account a modification of the linked surface and is recalculated on update.

② „Enable Daylight Curves“ (optional)

If this option is not selected the offset, if defined, will be created from the edge of the selected surface in field *Screen*.

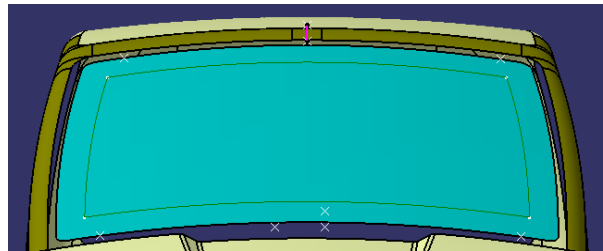
In practice the surface of the windshield contains also a black dotted area at the edge of the screen. But according to the standard this area must not be in the 25 mm offset.

If this option is selected the offset, if defined, will be created from the edge of the selected curve or line.

In this case the user has to select the daylight opening curve by one of the following options.

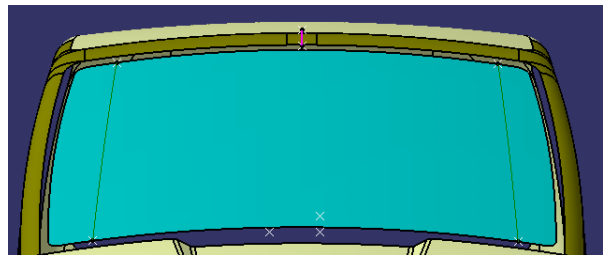
- Closed Curve

There is an existing closed curve (see fig.) for the *Daylight Opening*.



- Two Curves (left/right)

The *Daylight Opening* is defined by two boundary curves (see Fig.). Select the appropriate curve for the left and right side.



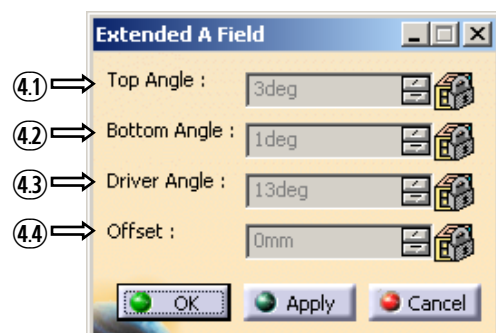
③ Visualization

With these options you can define which fields should be calculated and displayed in the model and whether they should be created as face or not. The creation of the face is necessary if the feature will be used as input for other CAVA functionalities.

④ Field Definition

By clicking on one of these buttons a dialogue box opens which contains the values to define the appropriate fields.

Button „Extended A-Field“



④.1 Spinner „Top Angle“

Angle of the plane starting from V1 with direction to the top.

④.2 Spinner „Bottom Angle“

Angle of the plane starting from V2 to with direction the bottom.

④.3 Spinner „Driver Angle“

Angle of the plane starting from the plane of the eye points in direction to the driver side.

④.4 Spinner „Offset“

Several standards define a minimum allowed offset of the fields of view to the outer edge of the windshield.

CAVA is internally creating an offset curve to the edge on which the fields of view are trimmed.

The value in this field can be changed by editing the parameter „*Offset*“ in the configuration file or using the *Free* mode in the GUI.

You can define only positive values.

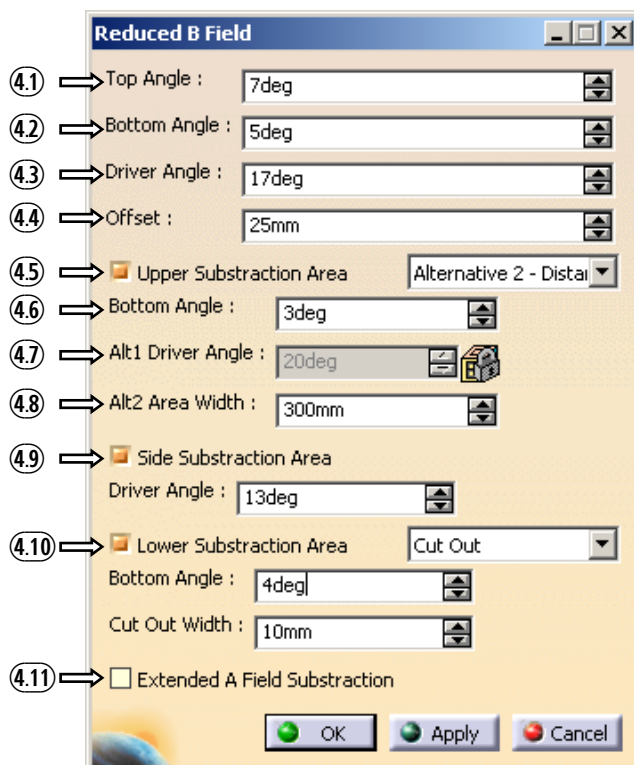


Remark: The fields are editable only in *Free* mode.

- Button „Reduced B-Field“

The general B-Field, that is defined by the parameter top angle, *bottom angle*, *Driver Angle and Offset*, can be reduced by several subtraction areas.

- **Reduced B field dialog box**



4.1-4.4 Definition of the general B-Field

4.5 Check box „Upper Subtraction Area“

Activate the Check box if you want to use an upper subtraction area for the reduced B field. Select the subtraction type in the list box. The types that can be used are described in the following. After the selection of the type the appropriate parameters can be defined.

List of the „subtraction type“:

- Type „Alternative 1—Angle“

Plane1—runs perpendicularly through V1 and V2, angled 20° from the *x* axis to the right.

Plane2—symmetric copy of plane1 to the vehicle mid plane

- Type „Alternative 2—Distance“

The limit to the left and right is defined by an area of 300 mm width that is centric to the vehicle mid plane.

④.6 Spinner „Bottom Angle“

Running parallel to the y-axis, going through V₁ and angled 3° to the top (this means the upper edge of the extended A-field). This angle defines the lower boundary of the upper subtraction area.

④.7 Value for the subtraction area type „Alternative 1 – Angle“

④.8 Value for the subtraction area type „Alternative 2 – Distance“

④.9 Check box „Side Subtraction Area“

Definition Side Subtraction Area:

Each light impervious covering on the left and right side of the windshield, resides below the intersection of the outside of the windshield with a horizontal plane going through V₁. The light impervious covering on the driver side is limited in direction to the middle of the windshield by the following planes:

„perpendicular going through V₁ and V₂ and angled 13° from the x-axis to the left “.

The limitation to the co-driver side is a mirrored copy of this 13°-plane to the vehicle mid-plane.

Procedure is analog to the upper subtraction area – see above ④.5 *Check box „Upper Subtraction Area“*.

④.10 Check box „Lower Subtraction Area“

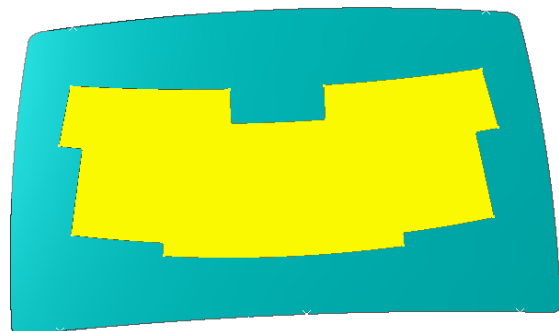
Procedure is analog to the upper subtraction area – see above ④.5 *Check box „Upper Subtraction Area“*.

Lower Subtraction Area

• Outside:

The 5° plane is considered between the lower vision points on the windshield.

The area outside the vision points is reduced from the general B-field



• Between:

The 4° plane is considered outside to the left and right of the lower vision points on the windshield.

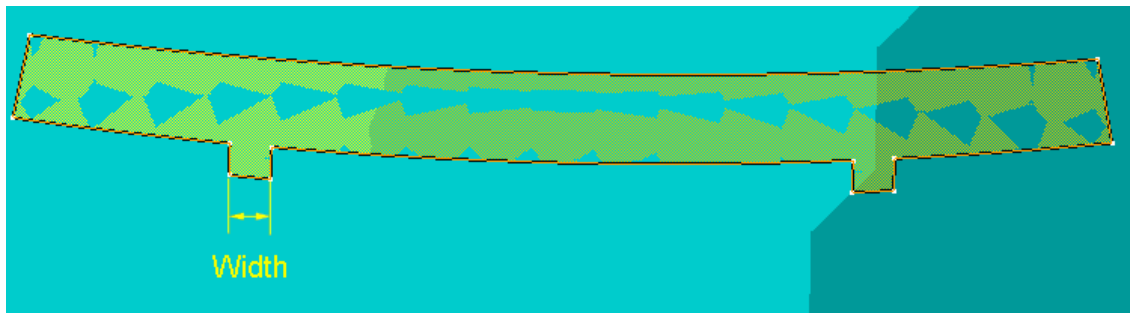
The area inside the vision points is reduced from the general B-field.



- Cut out:
The 4° plane is considered between and outside of the vision points on the windshield.
At the vision points the 5° -plane is used for consideration.



- Bottom Angle:
Angle of a Plane bent down, going through V2 and parallel to the y axis.
- Cut out Width:
Width of the remaining lower B-field for the option „Cut out“.



4.11 Extended A-Field Subtraction

- If this option is selected the B-field is subtracted by the extended A field.
(See figure on the right.)



The standards give leeway of interpretation of how the black dotted area on the windshield is considered for the minimum offset to the edge of the screen (offset-value). CAVA does not take it into account for the calculation. It depends on the user's selection for the windshield.
(See option „*Daylight opening Curve (optional)*“ above.)

6. A-Pillar Obstruction



Within CAVA it is possible to calculate the obstruction of the field of view by the A pillars corresponding to the EEC standard 77/649/EEC. The necessary input for such a calculation is the geometry of the A-pillar for at least one vehicle side.



The EEC directive describes the calculation method in great detail. The result is calculated in degrees and compared to the predetermined maximum value.

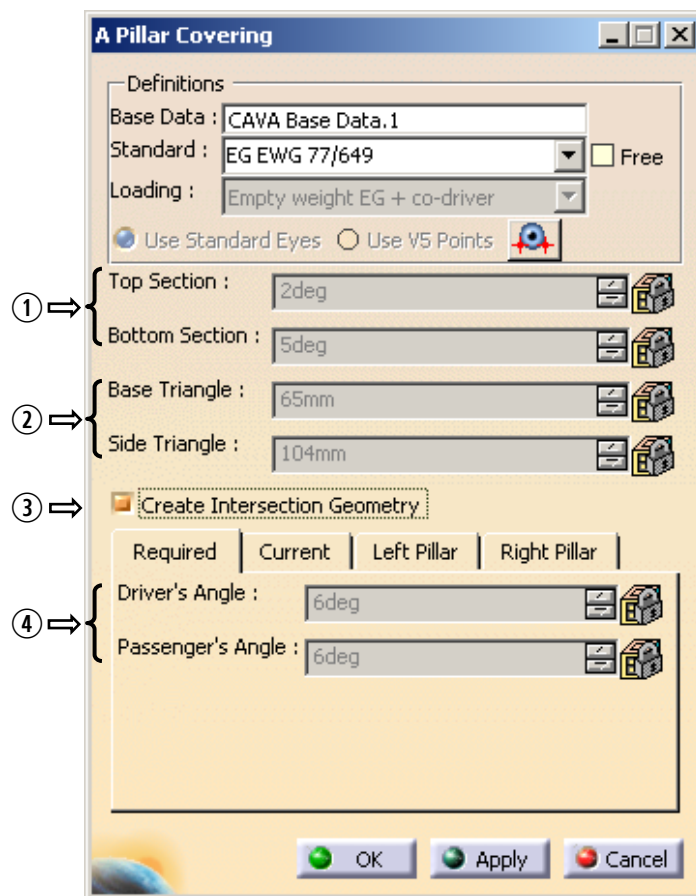


If symmetrical vehicle geometry is assumed, the requirement for the angle on the passenger side is automatically fulfilled if the angle on the driver side is "O.K.".



Depending on the geometry it is also possible to have negative angle values. This does not mean that the calculation is incorrect.

- *A-Pillar Obstruction* dialog box



① Top Section / Bottom Section

Definition of the two angles for the planes with which the A pillar geometry intersects first. (See step 1 in the following description.)

„Top Section“ defines the upward face and „Bottom Section“ the downward face (if both have a positive value).

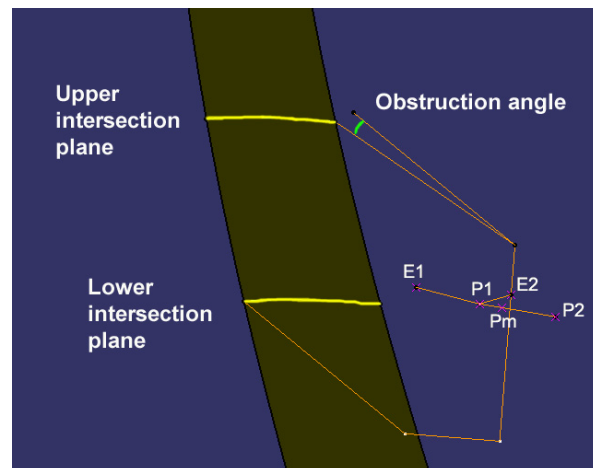
② Triangle definition for "head rotation" (Base Triangle / Side Triangle)

In order to determine the decisive E-points it is necessary to carry out a head rotation (see step 4 below), which is simulated with a defined triangle.

③ Create Intersection Geometry

You can optionally visualize the section geometry on the pillar in the model. The following elements are created:

- The (final) intersection through A-pillar (parallel to road)
- The most frontal point of the intersection
- Line P1 - P2
- E points

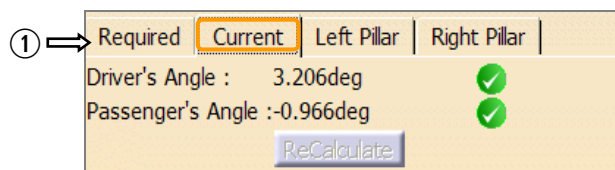


④ Required maximum values for the driver's and passenger's side (Required Driver's / Passengers angle)

Allowed maximum value ($< X$), defined in the default (configurable).

Representation of the calculated values ("actual values")




The "actual values" are shown in the second tab, but are consequentially only available after the selection of the A pillar geometry (see next step).



① Current values of the A-pillar obstruction for the driver's and passenger's side (Current Driver's / Passengers angle)

Value for the driver and/or passenger side, calculated using the current selected geometry.

For the recalculation of the elements (started automatically or by pressing the *Recalculate* button), there are three result symbols:

	Not Available	No element has been selected in the <i>Elements</i> Section.
	OK	The A-pillar obstruction is smaller than the allowed angle defines in the standard.
	Error	The A-pillar obstruction is larger than the allowed angle defines in the standard.



The „Recalculate“ button is necessary, if the automatic update of the feature is deactivated in the CAVA options. In this case the user must restart the calculation and the calculated value is not saved.



The colored icons show, whether or not a calculation has taken place and whether or not it corresponds with the predetermined maximum value.

Selection of the A-pillar geometry

You need the geometry of the A-pillar in order to calculate the obstruction. It can be defined separately for the left and the right side of the vehicle.



If the SRPs are modified with regard to a switch from right hand drive to left hand drive, it is not necessary to modify the geometry as in this case there is no distinction with regard to driver's and passenger's side.



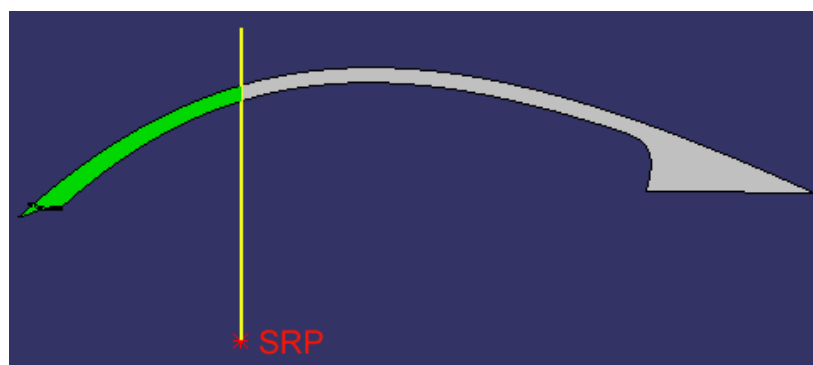
„Left“ and „Right“ in this case refers to the driver's point of view, i.e. for a left hand driver the left geometry is the driver's geometry.



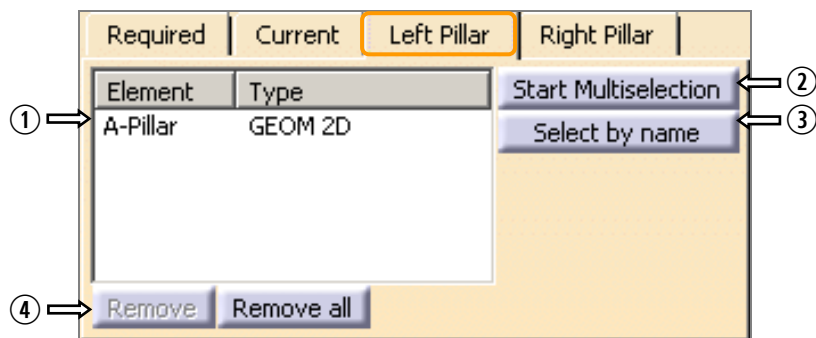
Various V5 elements can be selected as input geometry: surfaces, solids and wireframes.

However, it has to be taken into account, that these elements must form meaningful intersection geometry with the planes (see below). Otherwise the results are not significant.

Selected geometry that resides behind the Seating Reference Point (SRP), is not taken into account for the calculation. E. g. if the selected geometry contains the complete side frame including also the B- and C-Pillar, only the part in front of the SRP will be considered for the intersections (see fig. green area).



The User Interface is identical for both sides.



① List of the selected elements

Shows all currently selected elements for the respective side, as well as their type.

② Start Multi selection

This button opens a toolbar that contains several functionality for the selection of elements using traps.

Please refer to the description in the manual „CAVA General“.

③ Select by Name

This button opens a dialogue box, which enables the selection of a number of elements by name and type (analog to some functions of the OVA product).

④ Remove / Remove All

All elements of the list or a selected element in the list can be deleted.



The *Select By Name* function serves to make the selection of elements easier. The selection of names and types made in this function is not being automatically extended if additional elements corresponding to the search grid are created within the model.



Starting from version 1.12.1 it is possible to select also CGR geometry for the left and right A-Pillar.

Calculation of the obstruction

The calculation is carried out with the help of the algorithm described in the EEC directive. The individual steps are described (roughly) below:

- (1) Creation of two planes through the P_m eye point. The faces are tilted, parallel to the y axis and starting from P_m , downward or upward (depending on the configured values).

- (2) The A-pillar geometry intersects now with these two planes and the point on the intersection geometry which has the smallest x value (front most point) is being accounted.
- (3) Starting from these two front most points, the A-pillar geometry intersects with one plane parallel to the road surface, respectively. The thus resulting intersection geometry is being used to calculate the obstruction angle.
- (4) According to the standard a head rotation is simulated. This is done with the help of a triangle, the side length of which is defined (configurable). This triangle will be rotated until the tangent at the inner side of the intersection geometry (top) and one triangle side reach an angle of 90 deg.
- (5) The angle is now defined with the tangent at the outer side and the other intersection geometry.



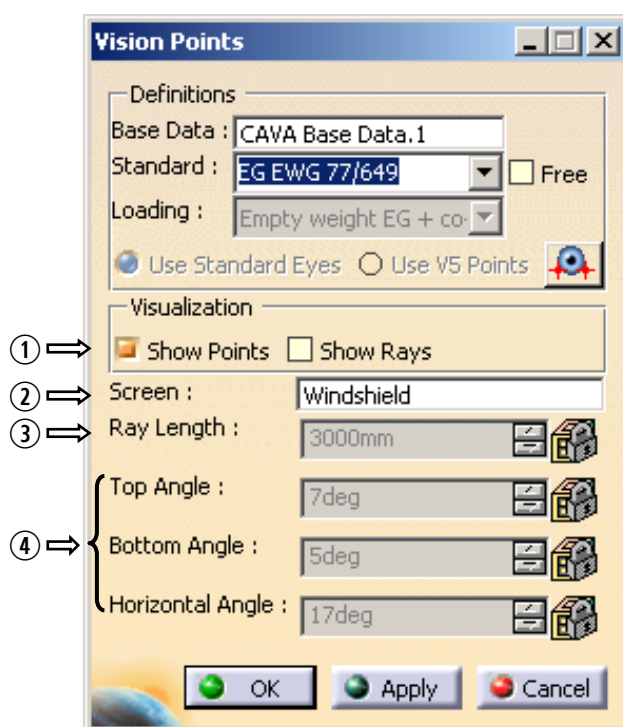
The old version of the standard, which can also be tested with this function, considers two planes parallel to the road surface at the beginning and simulates a head rotation until the tangent reaches an angle of 120 deg.

7. Reference Points on the Windscreen



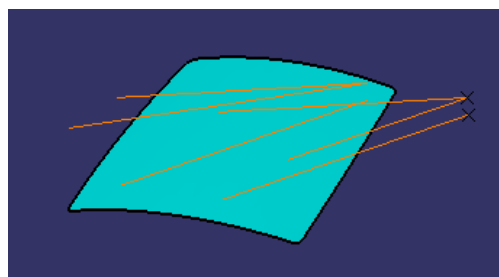
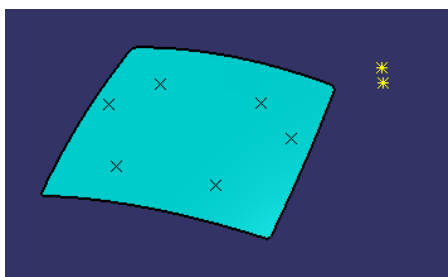
In the Standard 77/649/EEC six points are defined on the windscreen, which have to be positioned in the transparent area of the screen. Due to this requirement it is important for the designer to know the position of said points already when designing the windscreen. The points are determined on the basis of the V-points and are therefore determined clearly by the SRP and the screen. In case there is no geometry of the screen available, this CAVA feature can be used to visualize the corresponding rays.

- **Vision Points** dialog box



① Visualization

Select if the point and/or the corresponding rays should be visualized. The points can only be shown („Show Points“), if the windscreen is defined. The rays can also be shown („Show Rays“) without the definition of the screen (see fig. below).



② Screen

V5 face of the windscreen on which the fields of view are calculated. The face is linked associatively with the feature, i.e. the CAVA feature reacts to changes on the face. The entry can be omitted, if only the rays („Show Rays“) are shown.

③ Ray Length

If the „Show Rays“ button is active, the user can define the length of the rays here.

④ Definition values for the points/rays

Top Angle: starting from the top V-Point, the upper ray is defined by this angle (to the road surface).

Bottom Angle: starting from the bottom V-Point, the lower ray is defined by this angle (to the road surface).

Horizontal Angle: starting from the upper V-Point, the lateral ray is defined by this angle.

These angles refer to the driver's side, the rays / points on the passenger's side are symmetrical to the vehicle centerline.

These values are defined in the default and can therefore be edited by the user only in the *Free* mode.



At an early stage of vehicle development it is possible to show only the rays without defining a face for the screen. This facilitates the correct positioning of the screen, or possibly of the positioning of the black coloring on the screen border.

8. Vision Cone

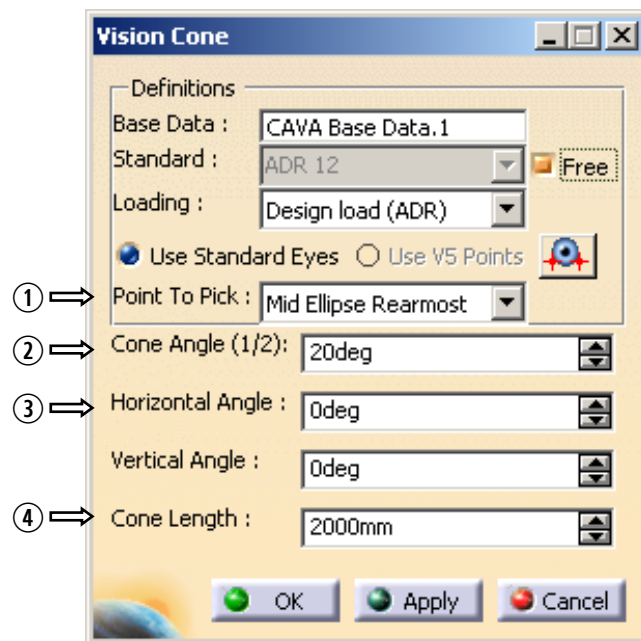


Due to changes in the ADR standards this function is no longer required for the homologation of a vehicle in Australia since spring 2004.

Originally ADR standards required (in simple terms), that within the vision cone no dazzling parts be placed.

CAVA creates the vision cone starting from eye ellipses and with the possibility to define varying sizes and positions in the defaults (configuration file).

- ***Vision Cone* dialog box**



① Eye point (Point to Pick)

Since for positioning the cone only one point is necessary, you have the possibility to determine the desired point dependent on the selected eye feature.

Eye ellipses for selection:

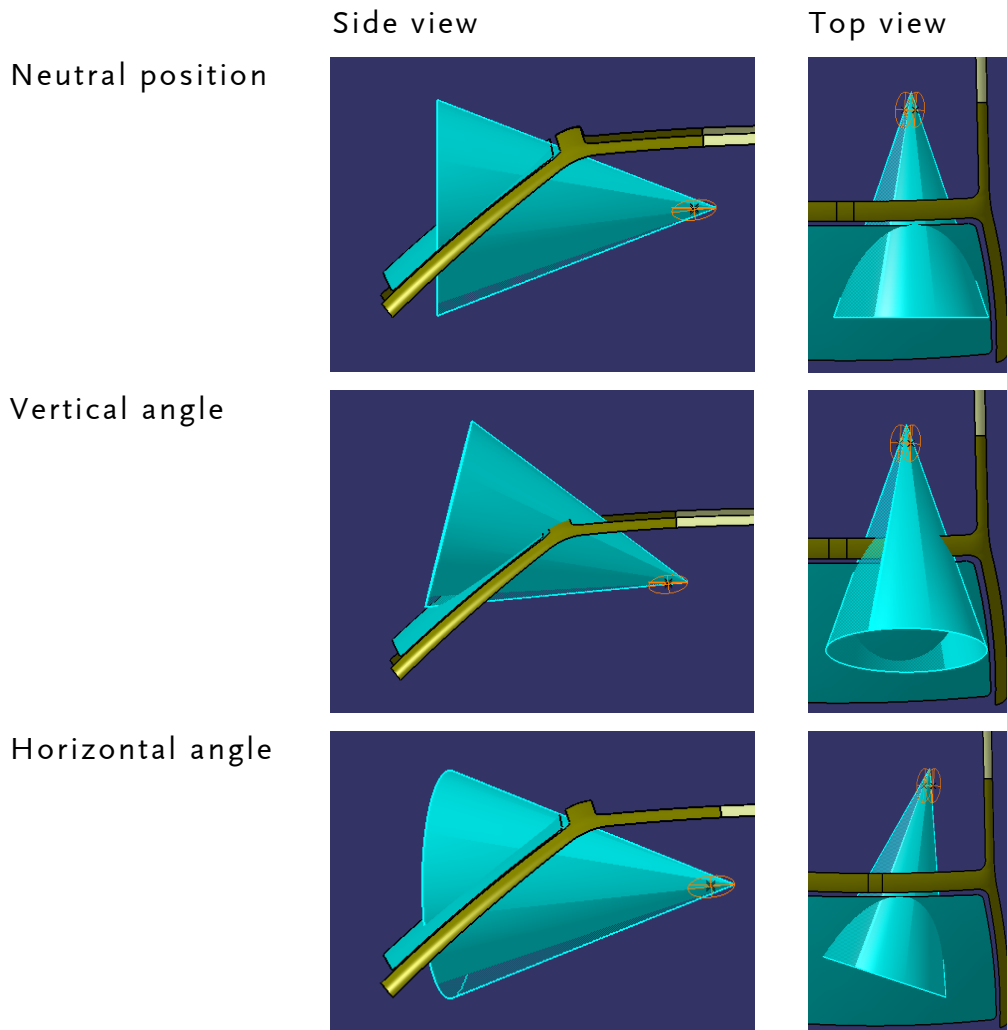
- | | |
|-----------------------------|---|
| • FwdLeft / FwdRight: | • front most point of the left or respectively right ellipse |
| • BckLeft / BckRight: | • hindmost point of the left or respectively right ellipse |
| • MidLeft / MidRight: | • middle point of the left or respectively right ellipse |
| • MidFwd / MidMid / MidBck: | • front most, middle or hindmost point of the "centerline" between the ellipses |

② Cone Angle ($1/2$)

Describes the opening angle of the cone.

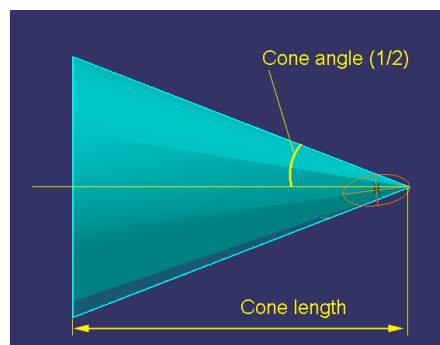
③ Horizontal / Vertical Angle

This two spinner boxes define the angle of the cone axis upwards/downwards and respectively laterally.



④ Cone Length

Defines the length of the cone. The value can be modified by the user at any time.



9. Vision Planes (Free Vision to the Front)



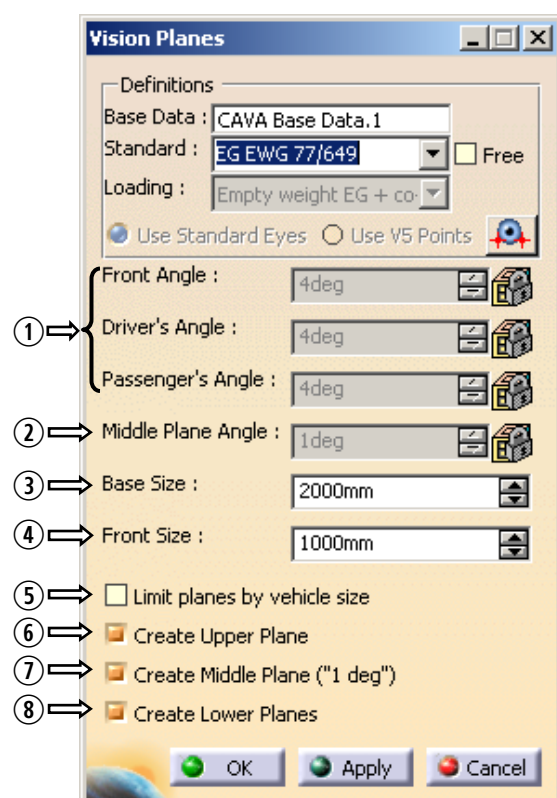
Within the 77/649/EEC directive, planes are defined starting from the V points, between which only specially defined vision obstructing elements can be positioned. With this CAVA feature the planes can be created dependent on the position of the eye points and the vehicle data, in order to consider the location of these planes already in an early phase of development.

CAVA does not check whether or which elements are located in this area, but it creates said planes in the corresponding position in the model.

The planes consist of the following:

The upper plane starts at the top V-point and is parallel to the road surface. The lower planes start from the bottom V-point and are inclined towards the front and the sides.

- *Vision Planes* dialog box



① Definition values for the planes

Front Angle: starting from the top V-Point, the upper ray is defined by this angle (to the road surface).

Driver's Angle: starting from the bottom V-Point, the plane on the driver's side is inclined downwards by this angle (to the road surface).

Passenger's Angle: starting from the bottom V-Point, the plane on the passenger's side is inclined downwards by this angle (to the road surface).

These values are defined in the default and can therefore be edited by the user only in the „Free“-Mode.

② Middle Plane Angle

Angle (to the road plane) of a plane starting from the lower V point to the front.

③ Base Size

Describes the lateral expansion of the geometry. If the „*Limit Planes by vehicle size*“ button is activated, the planes are limited if their lateral expansion protrudes over the lateral limitations of the vehicle.

④ Front size

Describes the expansion of the geometry towards the front.

⑤ Limit Planes by vehicle size

If this button is active, the planes are limited laterally by the points of biggest vehicle width (defined in the base data). This is only applicable if the lateral expansion is bigger than the width.

⑥ Create Upper Plane

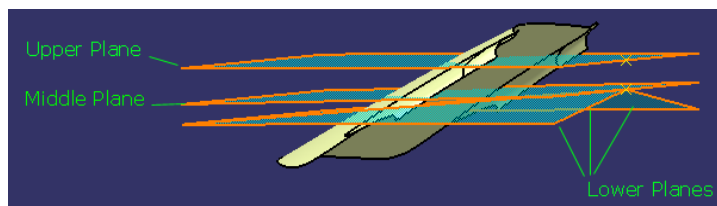
If this option is selected the upper plane will be created and shown in the model.

⑦ Create Middle Plane („1 deg“)

If this option is selected the middle plane will be created, using the angle to the road plane that is defined in ②. The plane is visualized in the model.

⑧ Create Upper Planes

If this option is selected the upper planes will be created, using the angle that is defined in ①. The plane is visualized in the model.



10. Optical Properties of the Windscreen

The optical properties of the windscreen are split into two CAVA features:

- Optical Distortion
- Double Image



As the usage of these two functions is analogical; hence they are described together in the following.



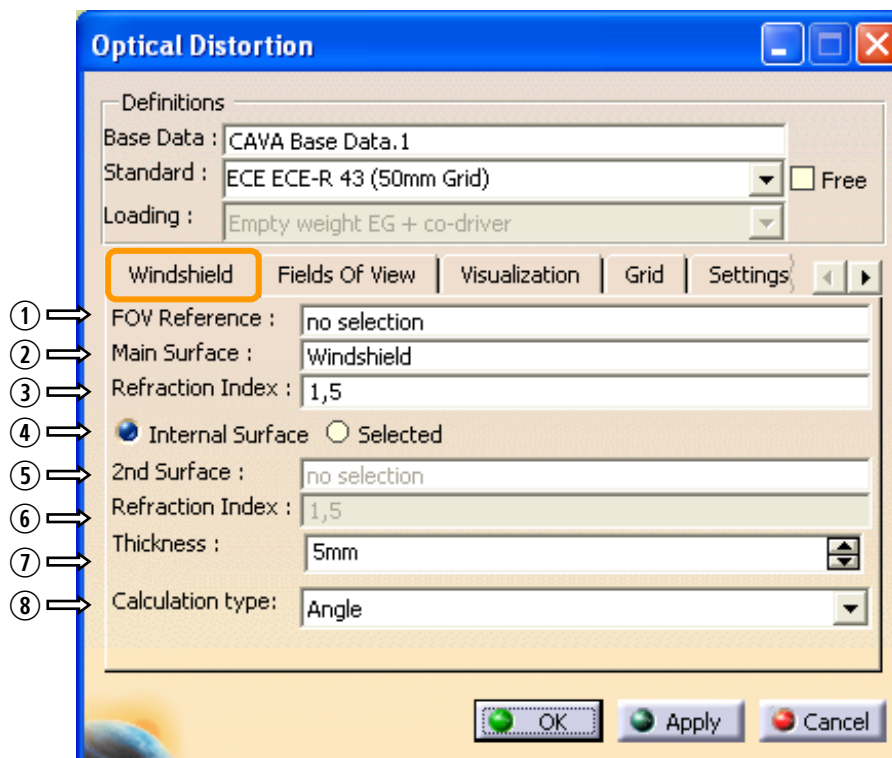
As opposed to other CAVA functions of the VISION product, the optical properties do not need eye definitions. In this case the direction of the rays according to the standards is running parallel to the road surface.

- **Definition of the Windshield**

The calculation of the optical properties is based mainly on the physical laws of refraction. Therefore the windscreen must be defined including the thickness of the pane. This can be done in two ways. If the inner side and the outer side of the pane are available as V5 planes, they can both be selected. However, it is also possible to define only one surface incl. a (constant) thickness.



When using the internally calculated offset, i.e. providing a V5 plane incl. A thickness of the glass, the direction of the normals of the original plane is important. Depending on the latter, the direction of the offset is calculated. This can be controlled with the use of a V5 invert plane.



① FOV Reference

Here you can reference an existing CAVA-Field of View feature from the model. The related surface of the windshield is automatically read and entered in field ②.

② Definition of the 1st surface (Main Surface)

V5 surface of the windscreen.

③ Refraction index of the 1st surface

Here you define a refraction index for the main surface. Usually the index is given by the manufacturer.

④ Definition of the type of second surface

It is defined, how the 2nd surface is specified, either through an internally calculated offset plane with a consistent offset value (Internal Surface) or by selecting a second V5 surface (Selected).

⑤ Definition of the 2nd surface

Depending on the setting for ④ (Definition of the 2nd surface), a second V5 surface has to be defined. In the case the internal offset plane is calculated, these elements cannot be edited.

⑥ Refraction index of the 2nd surface

The refraction index will be taken from the field for the refraction index of the main surface.

⑦ Thickness of the glass

Depending on the setting for ③ (Definition of the 2nd surface), a consistent glass thickness for the windscreen has to be specified. If the 2nd surface is selected, this entry field cannot be edited.

⑧ Calculation type

You can visualize the calculated results optionally as angle or as dioptre values (see tab card „Visualization“).

The definition of the above mentioned parameters is sufficient for the calculation of the optical properties of the whole surface.



If, despite correct entry values, no results in the form of points, normals or respectively lines are visible, it is most probable that the visualization options are set in a manner, that only critical points are shown (see Visualization Options).

- **Optional Values for the Fields of View**

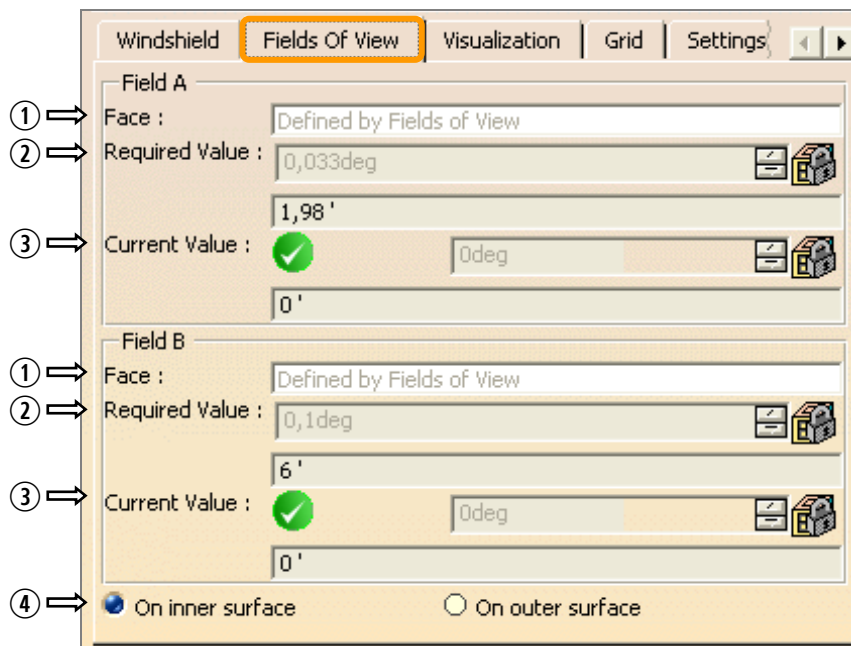
The required values in the standards refer to specific limited areas on the windscreen, the so-called fields of view (as shown in 3). In order to verify the required values for the individual fields of view, they can optionally be specified in addition. As a result the user receives the maximum value in the area of the field of view.




The standards refer partly to the extended or respectively reduced fields of view, which are not (yet) implemented in CAVA. In order to enable specification anyway, any V5 surfaces are accepted as input. Proceeding from the assumption that they are located on one of the input areas for the windscreen.



When using fields of view created in CAVA, they have to be created as planes and subsequently selected individually.



 Fields A ①②③ are analog to fields B ①②③ respectively.

① Face text box

Selection field for the field of view. A V5 surface is the input, e.g. the output surface of the CAVA Feature „Fields of view on the windscreen”, if the fields of view are created as planes.

② Required Value for the field of view

A value defined in the configuration file as a minimum angle for the corresponding field of view.

The value is displayed once in degree and twice in angular minutes.

③ Current Value for the field of view

Current calculated value for the selected field of view.

The value is displayed once in degree and twice in angular minutes.

For the calculated values, there are three result symbols:



Not Available

No calculation is possible, because e.g. the field of view is not selected.



OK

The reflection angle is smaller then the maximum allowed angle for the respective field.



Error

The reflection angle is larger then the maximum allowed angle for the respective field.

④ Position of the fields of view

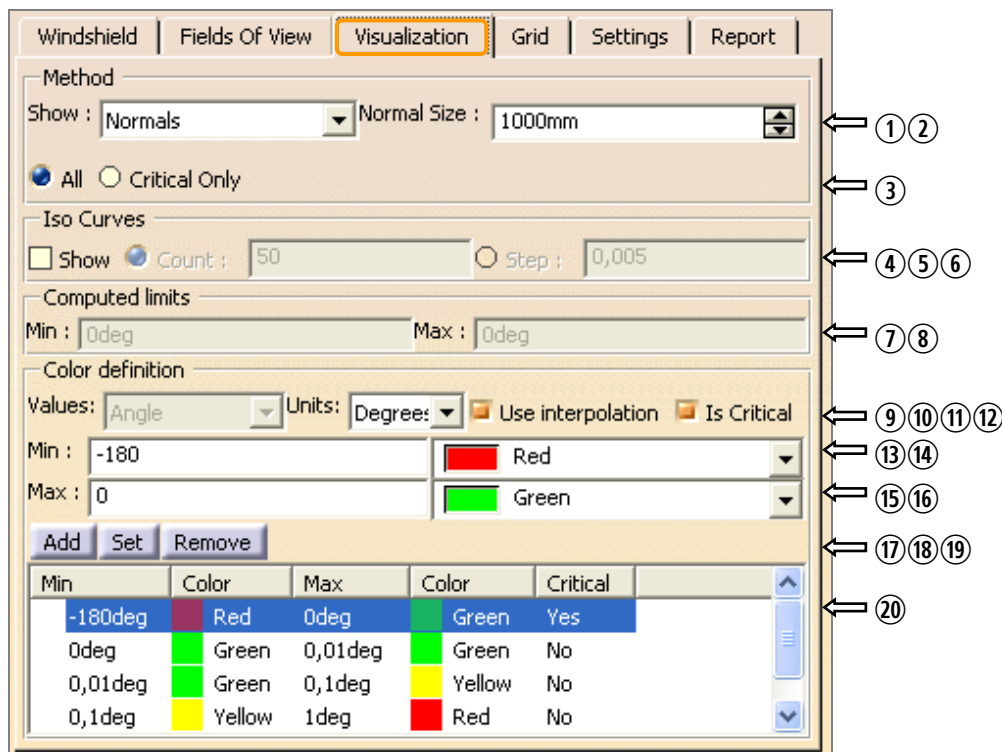
It has to be specified on which of the two input fields of the windscreen, the fields of view are located.

• Visualization Options

Varying visualization options can be set for both features. The results can be shown in the form of points or iso-lines.



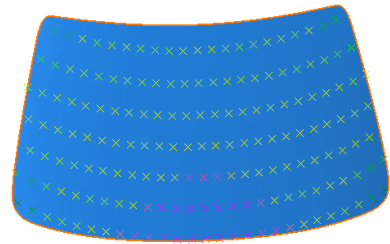
Visualization of the results is here always carried out with the help of pure visualization element, i.e. points, or respectively iso-lines; they are not available as V5 geometry elements. They can therefore not be used for measuring, generative drafting etc. However, representation and memory management are considerably more efficient.



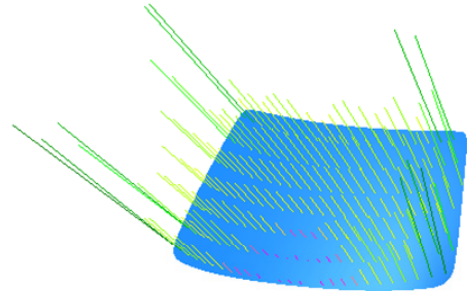
① Representation of results (Method)

Intersections

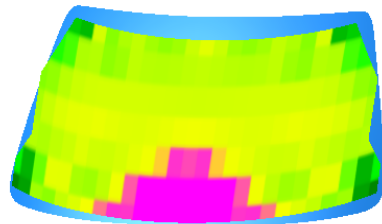
The results are shown as colored points on the windscreen.

*Normals*

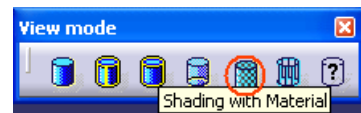
The results are shown as normals (porcupine), and the stated length defines the scaling factor.

*Color Map*

The results are shown as colored area.



For the *Color Map* visualization method you have to activate the *Material* mode in CATIA.



② Normal Size

(Only active if the representation method *Normals* is selected in field ①)

This value defines the length of the normal for the maximum calculated result. The length is used as scaling factor for all the other result values.

③ „All“ / „Critical Only“

Select whether only the critical results or everything should be visualized. The definition of critical results is done with the option described below (number ⑩)

④ Representation as iso-curves

Along with the representation as points, normals or respectively as color map, it is also possible to visualize the results in the form of iso-curves, i.e. points with the same angle value are lying on a curve.

⑤ Count

If you have selected this option you can define the number of iso-curves. You can create up to 50 iso curves.

The range between the calculated minimum and maximum is divided into N equal steps (where N is the number specified in the field *Count*). For each of these step values CAVA creates an iso curve.

⑥ Step

If you have selected this option you can define a step value for the creation of the iso curves. Outgoing from the calculated minimum CAVA is creating an iso curve every N degrees or dioptries (where N is the value selected in the field *Step*)

⑦⑧ Computed limits

The *Min* and *Max* fields contain the smallest and largest calculated value of the optical distortion. The unit of the visualized values is depending on selection made in field *Units* (see ⑩).

These values are intended to give you an orientation of how to define the ranges for the color settings in the list.

⑨ Values

Here you can select whether you want to have the calculated results as angles or as dioptry.

⑩ Units

While you have selected the option Angle in the Values field you can select whether you want to have the calculated results as degrees or as minutes.

⑪ Use Interpolation check box

- When this check box is activated, for the color representation of the value range one color may be used for the maximum value and one more color for the minimum value.
- The intermediate values will be displayed with interpolated color values. When this check box is deactivated, each value range completely will be displayed in one only color (i.e. the color, selected in the color list box on the right of the *Min* text box).

⑫ Is Critical

Activate this option to define the range as critical. The results will than be visualized if you have selected the option to only show critical results (see above number ③)

(13-16) Min and Max text boxes and color list boxes

In the *Min* and *Max* text boxes the lower and upper limit value of the value range to define can be specified.

With the color list boxes to the limit values colors can be assigned. The color list box on the right of the *Max* text box is active only if the *Use Interpolation* check box is activated. (Cf. description of the *Use Interpolation* check box (11).)



While defining the angle ranges, take care that the value ranges do not overlap. A range that overlaps a range that has been defined before can not be added to the list (an error message will be displayed).

(17) Add button

Press this button to add to the list the values defined in the boxes (13-16).

(18) Set button

To modify values in the list, mark the respective line in the list. The values then will be displayed in the boxes (11-14) and may be modified. Thereafter press the *Set* button to add the modified values to the list.

(19) Remove button

To remove a line from the list, highlight this line and press the *Remove* button.

(20) List of the defined ranges with assigned colors

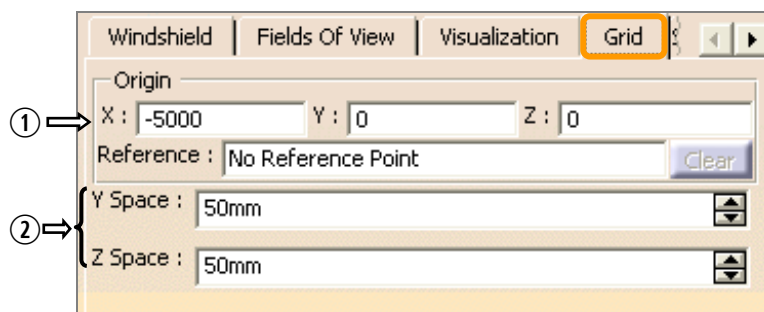
This list contains all specified value ranges with their attributed colors, defined with the boxes (13-16)

• Definition of the grid

The points are distributed on the windscreen with the help of a defined grid. This grid is defined by an origin, a direction and a spacing in the *y* and *z* directions.



The values for the grid are defined in the default and can therefore be edited by the user only in the *Free* mode.



① Origin

Origin for the definition of the grid. It should be defined in sufficient distance from the windscreen. The point grid is calculated originating from this point in the specified direction. The specification is carried out analog to a V5 point over an optional reference point and/or the specification of the coordinates.

② Spacing in y and z direction (Y / Z Space)

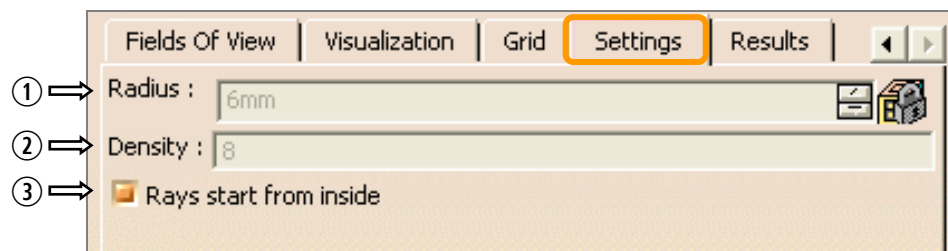
These values define the spacing of the grid points in the two directions and orthogonal to the direction of the grid (Default Y and Z).

- **Settings tab card**

In this case, the two features 'Optical distortion' and 'Double Image' differ.

- „Optical distortion“

The optical distortion at a point is defined by a default as the maximal deflection between this considered point and neighboring points in a defined circular environment. The radius for these neighboring points and their number is defined here.



① Radius

Radius, in which the neighboring points are considered for the comparison of the deflection.

② Density of points

Defines the number of neighboring points to consider on the circle around the current point.

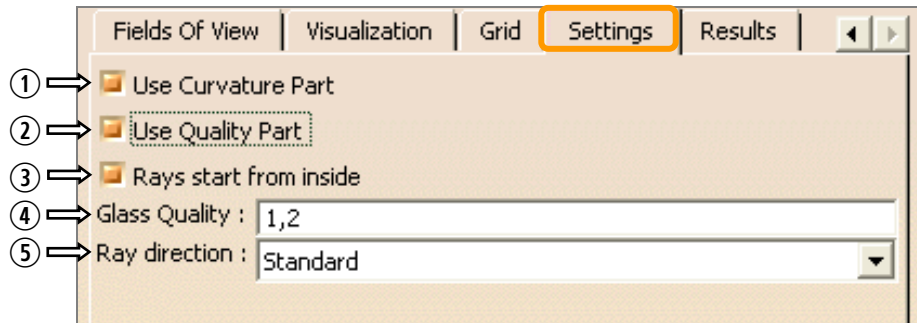
③ Rays start from inside

By selecting or deselecting this option, you can flip the direction of the sight rays.

- „Double Image“

Double Images are mainly influenced by two variables, which can be considered separate from each other. These are the part influenced by the curvature of the pane as well as the

part, determined by the quality ("wedgeness") of the glass. These two parts are summed up to a total value. In order to analyze the influence of these two variables separately, the user can choose, which of the parts should be considered.



① Use Curvature Part

If this button is selected, the curvature part is considered. Depending on the setting for the quality defined part, it will possibly be summed up with it.

② Use Quality Part

If this button is selected the quality part ("wedgeness") is considered. Depending on the setting for the curvature part, it will possibly be summed up with it.

③ Rays start from inside

By selecting or deselecting this option, you can flip the direction of the sight rays.

④ Glass quality

Defines the value for wedgeness. It is provided by the glass producer. A typical value is e. g. 1.2.

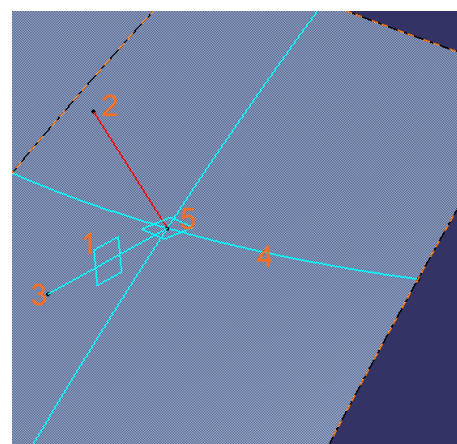
⑤ Ray direction

• **Standard**

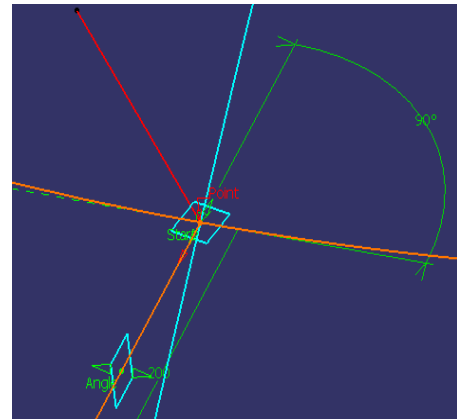
A curvature of an intersecting curve at grid point is calculated.

The cutting plane (1) which defines the intersecting curve is defined by:

- surface normal at grid point (2)
- by a line (3) perpendicular to an intersection line (4) which is created by the intersection of a plane parallel to road (5) going through grid point and the windshield.



Detail view for step (3) ►

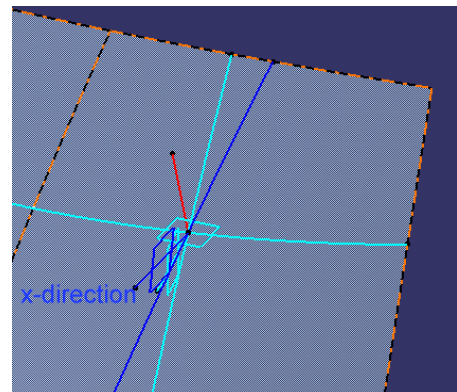


- *X* Direction

A curvature of an intersecting curve at grid point is calculated.

The cutting plane (1) which defines the intersecting curve is defined by:

- Surface normal at grid point.
- by a line in relative *X* direction to an intersection line which is created by the intersection of a plane parallel to road going through grid point and the windshield.



- Results tab card

① Static Calculation

This option allows you to calculate the optical properties for a specific point on the windshield. To do so, enter the x, y and z-coordinates in the fields and click on the *Calculate* button. The measured result is shown in the *Result* field.

② Interactive Calculation

This option allows you to indicate a position in the 3D model and calculate the optical properties for this specific position.

Click the *Start* button and move the mouse cursor around some windshield geometry (The cursor symbol will change to the hand symbol). The coordinates of the actual calculated point are visualized in the coordinate fields. The measured result is shown in the *Result* field.

Click on the *Stop* button to cancel the interactive calculation.

③ Generate Report

In order to document the angle values of the single points, these two features offer the possibility to generate a report for the optical properties.

In this report the individual points with their coordinates, the normal to the point and the curvature and angle values are documented.

The target file can be specified with the *Browse* button. The text format is ASCII. After pressing the *Generate* button the report is generated.

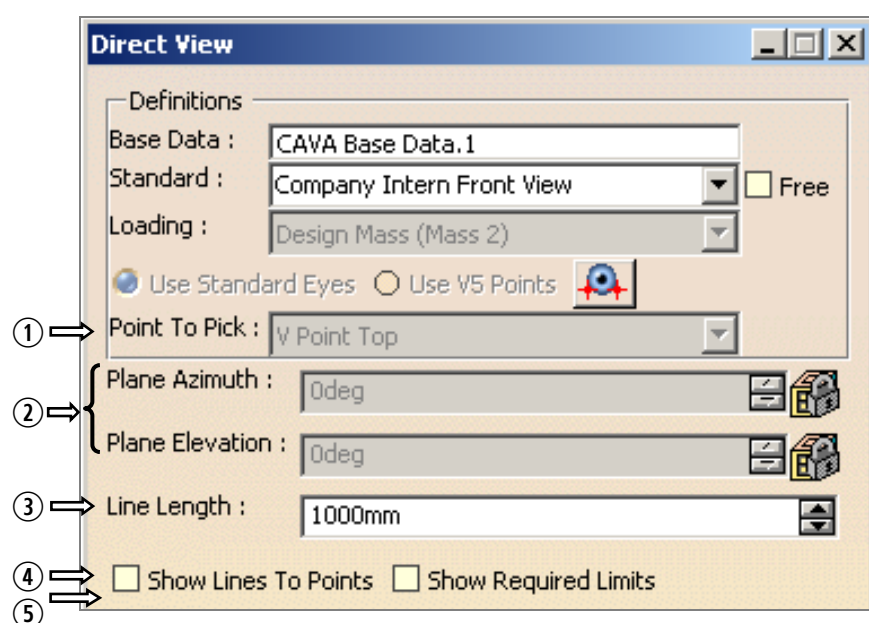
11. Direct View to the Front / Rear



This CAVA function checks the view in a defined direction, e.g. to the front or to the rear. The aperture angle between the possible top and bottom vision rays is considered through a window. The limiting geometry of the vehicle can be taken into consideration. These requirements are not described in official standards but are usually internal company guidelines.

In addition, it can be tested, whether or not certain points outside of the vehicle, e.g. a traffic light or a pedestrian, are visible or whether or not the vision is obstructed.

- *Direct View* dialog box



① Point To Pick

Select an eye point from which the angle should be measured.

② Plane definition (Plane Azimuth / Plane Elevation)

Describes the plane in which the two rays are considered. In this plane it is checked in how far the selected window pane or respectively the limiting geometry are limiting vision. The plane is not necessary for the verification of the visibility of defined points.

Azimuth describes rotation around the vertical axis (view to the rear = 180 deg).

Elevation describes rotation around the horizontal axis (normally = 0 deg).

③ Line Length

Describes the length of the rays when they are shown. This value can be edited by the user at any time and has no impact on the calculation.

④ Show Lines to Points

In the default or respectively in the *Free* mode, you can define points for this feature, which are tested with respect to their visibility. If this option is activated, these rays are shown. Depending on the fact, whether they are visible (green) or not (red).

⑤ Show Required Limits

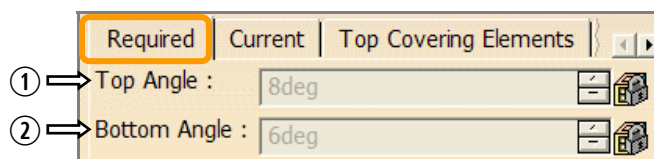
Visualizes the upper and lower limits as lines in the model.

Required / Current Angles

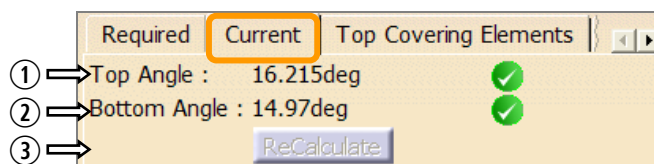
On the first tab („*Required*“) the required angle values are defined. These values are defined in the default and can therefore be edited by the user only in the „Free“-Mode.

On the second tab („*Current*“) the current calculated angle values are defined.

- **Required values tab card**



- **Current values tab card**



① Top Angle

Angle of the top vision ray, measured with respect to the horizontal.

② Bottom Angle

Angle of the bottom vision ray, measured with respect to the horizontal.

③ ReCalculate

Depending on the administrative CAVA settings for updating the calculations, they have to be activated manually if required.

For the calculated values, there are three result symbols:



Not Available No element has been selected in the *Elements* Section.



OK The calculated angle is bigger than the upper or lower minimum angle limit.



Error The calculated angle is less than the upper or lower minimum angle limit.

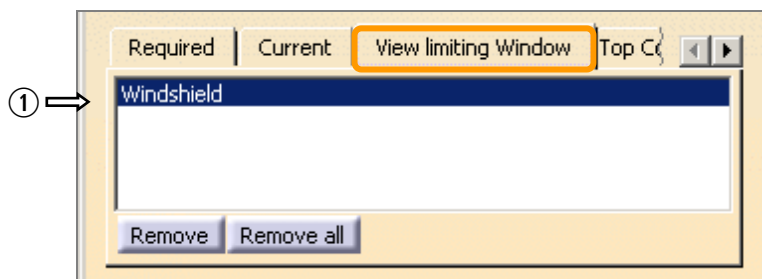


Orientation towards the top or the bottom depends on the selected elevation angle of the plane. If it is rotated around the horizontal axis (elevation <0 or >0), the terms 'top' and 'bottom' are not necessarily correct anymore.



If there is a shortfall of the required angles, the feature is marked as “faulty”.

• View limiting window



① *View Limiting Window*

Selection of a V5 surface that represents the window. For the front view it is the windshield, and for the back view it is the rear shield.

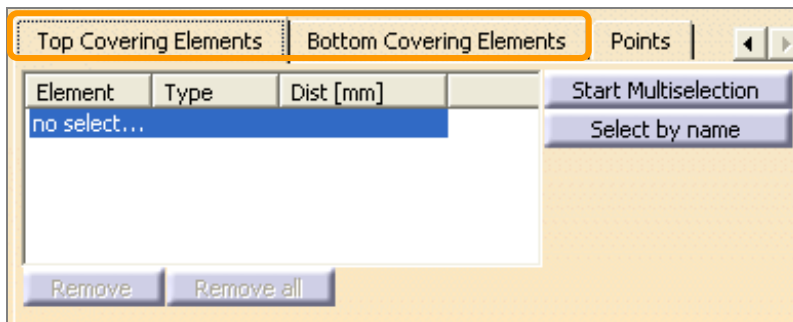
The geometry is used to determine the two „Extreme“ sight rays.

The list can contain several surfaces.

• Limiting Geometry

If along with the selected pane you also want to consider the geometries of the vehicle, in order to calculate the vision angle, you can select them as „*Top Covering Elements*“ or „*Bottom Covering Elements*“.

- Top Covering Elements: Planes limiting the view from above, e.g. Sun visor
- Bottom Covering Elements: Planes limiting the view from below, e.g. the engine hood with respect to the front view.



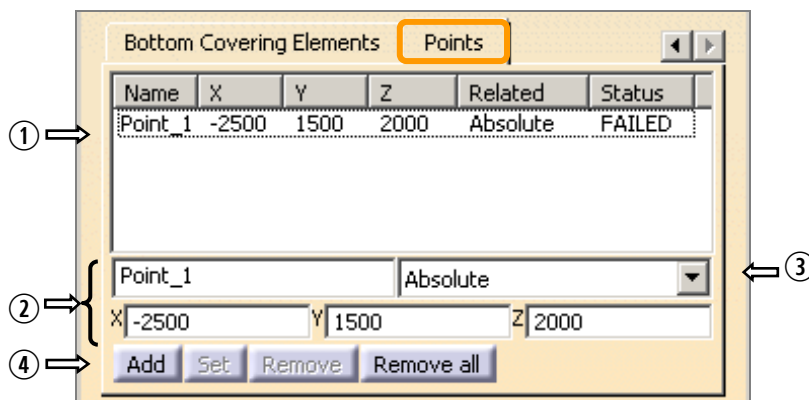
Calculation is carried out in the defined plane, within which the vision rays are moved upwards or respectively downwards, until they reach either the border strip of the pane or the selected geometry.

• Visibility of Defined Points

Along with calculating the vision angle, this CAVA feature can also check whether or not specific points are visible. This can e.g. be points that describe a traffic light or a pedestrian.



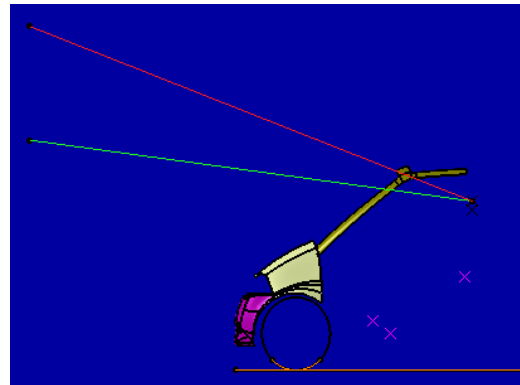
For the verification of the points the selected pane and the limited geometry are considered. The position of the plane has no relevance for the calculation.



① List of the current points

Contains the points with their absolute coordinates and their current status (OK / FAILED).

If the option *Show Lines to Points* is active the lines to the points will be visualized in the colors red for FAILED and green for OK.



② List box for points reference

Here either a point can be created by entering its coordinates in the respective boxes or an existing V5 point from the CATIA workspace can be referenced. If by the user for a newly created point no name has been specified, CAVA defines a default name that can be changed, if necessary. For the actually selected point the reference (see below) and the coordinates can be specified.

③ Reference list box

Here for the selected point a relation can be selected:

- Absolute
The coordinates are related to the absolute coordinate system.
- Car—Front
The x coordinate relates to the end of the frontal overhang of the car. The y and z coordinates relate to the absolute coordinate system.
- Car—Back
The x coordinate relates to the end of the rear overhang of the car. The y and z coordinates relate to the absolute coordinate system.
- Eyes—MidPoint
The coordinates relate to the eye point that has been selected in the *Point to Pick* list box.

④ Add/Set/Remove/Remove All buttons

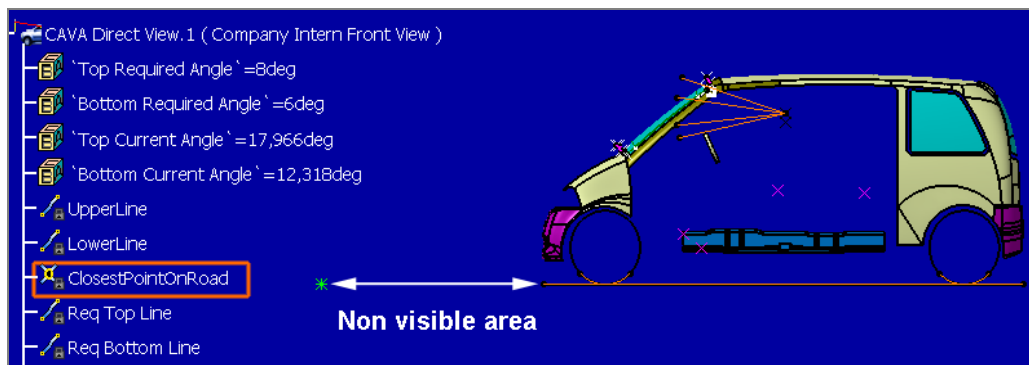
- Add: Adds a point to the list.
- Set: Confirms the modification of a selected point in the list.
- Remove/Remove All: Removes from the list the selected/all point(s).



If one of the points is not visible due to the selected geometry (pane or limited planes) the feature is marked as „faulty “

• Closest point on road

CAVA calculates automatically the first point that is visible on the road according to the selected view limitations. (Between the vehicle and the calculated point on the road is situated the area can not be seen by the driver.)



12. Direct View 3D



This CAVA function enables you to check the driver's view in 3D and thus potential obstruction caused by the vehicle geometry. At the moment this check is not according to official standards but the driver's view is an important aspect in the vehicle concept in general.

The function enables the usage for different needs. You can check the obstruction of the dashboard caused by the steering wheel as well as the obstruction by the A-, B- or C-pillar and the view to the road in general.

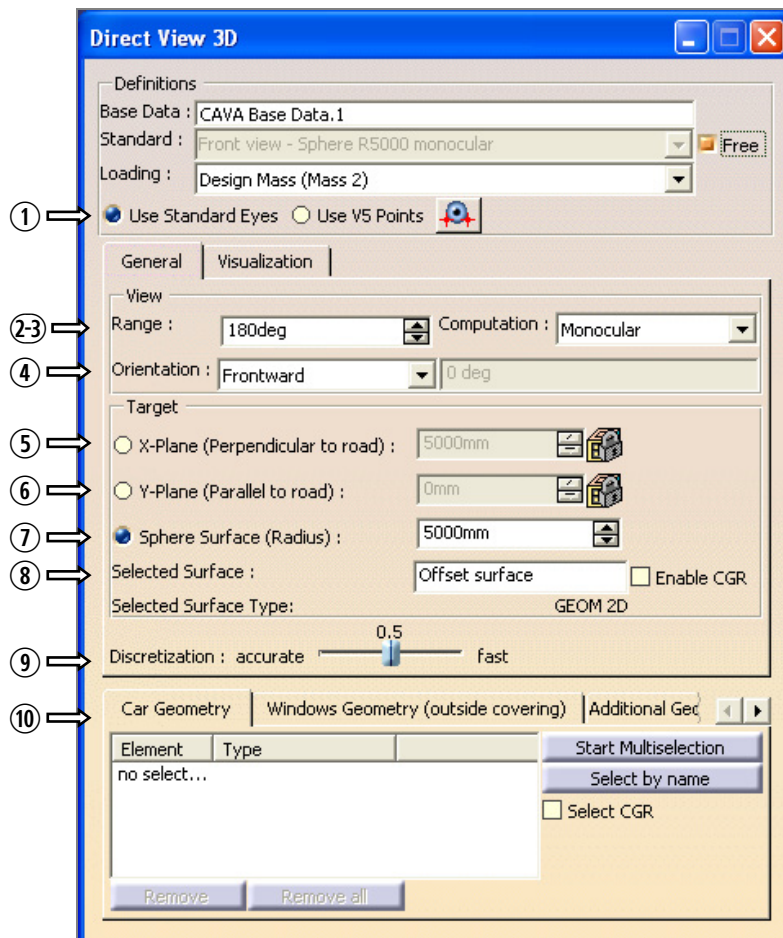
Starting from the eye points the obstructed area can be calculated for monocular view as well as for ambinoocular view and the appropriate reflection curves are visualized on the vehicle geometry.

The computation is always associated to a defined target plane (plane or sphere) on which the discretization is accomplished for the calculation. The result can be displayed on the target plane or any arbitrarily surface.

- General Inputs

After having selected the base data and the used standard you have to define the general input data.

- Dialog box „Direct View 3D“



① Eye point definition (only enabled in „Free“ mode)

Here you can select the eye points that will be used for the calculation (see chapter 2.2.1).

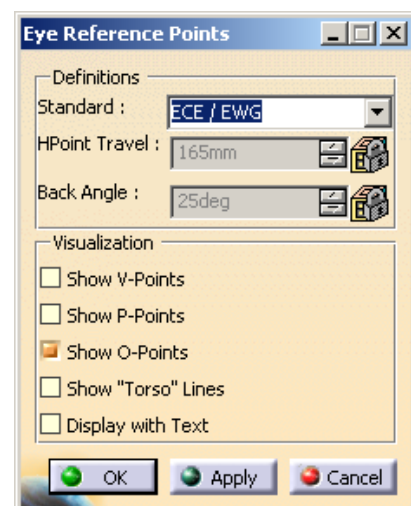
The default selection is “Use Standard Eye”. At this the eye points are calculated internally by the CAVA application.

The „O-Points“ are used as eye point type, i.e. the eye points are analogue to the EU Standards for the rear view mirror (653 mm above the SgRP, and 32,5 mm in both positive and negative y -direction).



Click on the eye point icon.

The dialog box for the eye-point settings will open.

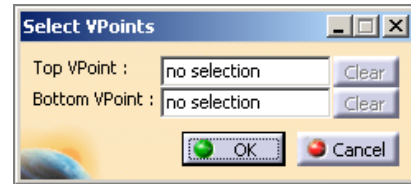
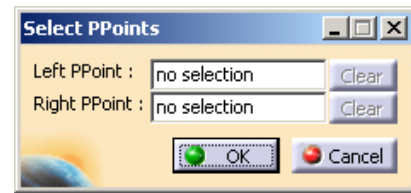


In the „Free“ mode you can select the option „Use V5 points“ to define any V5 point as eye point (P-point).



Click on the eye point icon.

A dialog box will open. In the fields „Left PPoint“ and „Right PPoint“ or „Top VPoint“ and „Bottom VPoint“ (depending on the used CAVA function) you can assign the according eye points to the respective V5 points in the model.



• General/tab card

View

② Range

This angle defines the sight range to the front that has to be checked. The starting point is the standard eye point from which the range is going half of the angle in clockwise direction and half of the angle in counter clockwise direction.

③ Computation

Here you can define the calculation method that should be used. The „Monocular“ option calculates the monocular view from the mid point of the two eye points. The „Ambinocular“ option uses the right and left eye point as they were defined under ① for the calculation.

④ Orientation

By default the target plane is created in negative x-direction (frontwards).

Use the Free mode to define a different orientation of the target plane. You can choose the directions *Frontwards*, *Backwards*, *Left*, *Right* and *Free* from the selection list.

If you have chosen the *Free* option you will have to define the angle for positioning the target plane in the field beside the list box.

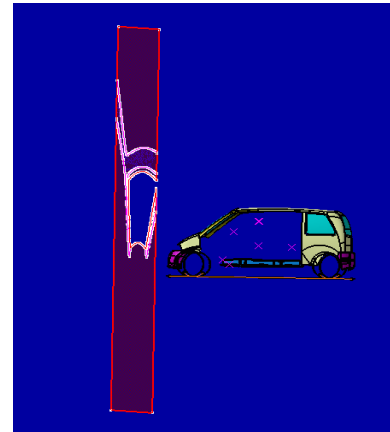
Target

For the calculation of the view a parametric defined surface is needed. On this surface CAVA internally creates discrete points that are used for the contour calculation and the view obstruction.

The sight rays are determined starting from eye points to the target surface. Obstruc-ting elements that are behind the target surface (regarding from the eye point) will not be taken into account.

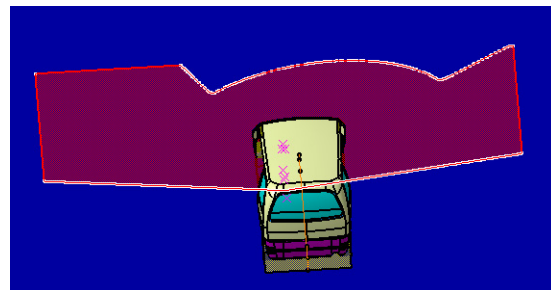
④ *x* Plane (perpendicular to road)

Select this option to create a target plane perpendicular to the road. In the field beside the option button you have to define the offset from the eye points (mid eye point) to the target plane. The extension in *y*- and *z*-direction is given by the value defined in field *Target Plane Max Size* on tab card *Visualization/Options*.

⑤ *y* plane (parallel to road)

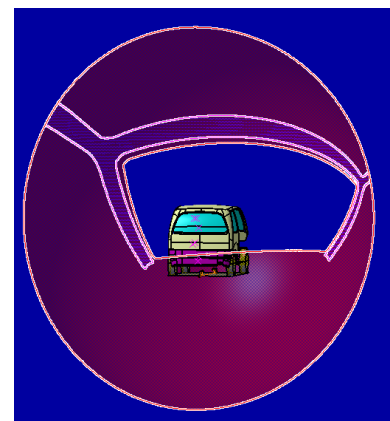
Select this option to create a target plane parallel to the road. In the field beside the option button you have to define the offset to the target plane. The extension in *y*-direction is given by the range angle defined in field ② or is limited by the maximum size of the target plane.

The extension in *x* –and *y*-direction is given by the value in field *Target Plane Max Size* on tab card *Visualization/*



⑥ Sphere surface

If you have selected this option the target plane will be visualized as sphere surface. In the field beside the option button you have to define the radius to determine the extension of the sphere surface. The sphere surface will be created with the range angle defined in ②.



⑦ Selected surface / Surface Type

In addition you can also select an existing V5 surface on which the view contours should be calculated and displayed. This will be a meaningful option if the visualization of the view obstruction should be analyzed on a special given surface.

Take into account that the surface has to be in front of the target plane (regarding from the eye points) because the offset of the target plane defines the limit of the calculated range. If the selected surface is behind the target plane the contours will not be calculated and displayed.



The projected geometry on a selected surface is only shown as wire geometry. CAVA cannot create fills of it as it can do on the default target planes.

This is handled in that way because the selected target surface could also be a cgr geometry - and on cgr geometry we cannot create fills.

⑧ Discretization

Using this slider you can determine the accuracy of calculation. Select a value between 0 (accurate) and 1 (fast).

⑨ Geometry selection

In the different tab cards you can select the respective geometry that should be used for the calculation.

- Car Geometry:

Here you have to select in the model the geometry that is defining the vehicle.

- Outside Covering Geometry:

Here you have to define the geometry of the vehicle which outer areas are obstructed. These are e.g. the vehicle's windows.

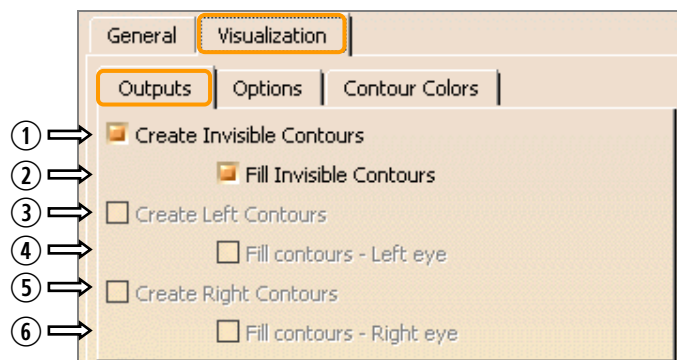
- Additional Geometry:

In this list you have to add geometry that should be checked and visualized additionally by the program but that are not considered as covering geometry.

- **Visualization tab card**

Outputs

On this tab card you can define the way how the calculated results should be visualized.



① Create Invisible Contours

The contours of the non visible areas will be displayed on the target plane or on the selected surface.

② Fill Invisible Contours

If this option is activated the contours of the non visible areas will be displayed as filled surface.

The following options are only available if the ambinoocular view is activated in the field *Computation* (tab card *General*).

③ Create Contours – Left eye

If this option is activated the contour of the selected geometry for the left eye is displayed on the target plane or on the selected surface.

④ Fill Contours – Left eye

If this option is activated the contours for the left eye will be displayed as filled surface.

⑤ Create Contours – Right eye

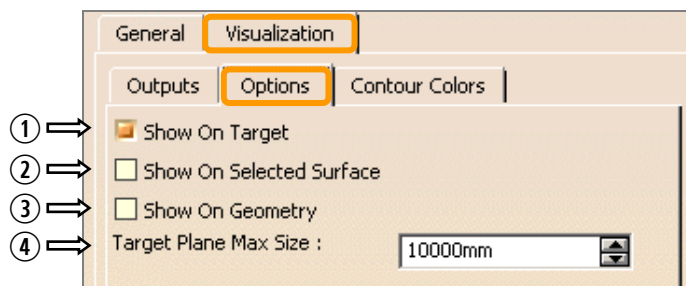
If this option is activated the contour of the selected geometry for the right eye is displayed on the target plane or on the selected surface.

⑥ Fill Contours – Right eye

If this option is activated the contours for the right eye will be displayed as filled surface.

Options

On this tab card you have to define where the calculated results should be displayed.



① Show On Target

The calculated contours will be displayed on the target plane that is selected on the tab card *General*.

② Show on Selected Surface

The calculated contours will be displayed on the selected surface.

Please take into account that the surface is in front of the target plane because the offset to the target plane defines the limit for the calculated area. If the selected surface is behind the target plane the contours will not be calculated and displayed.

③ Show On Geometry

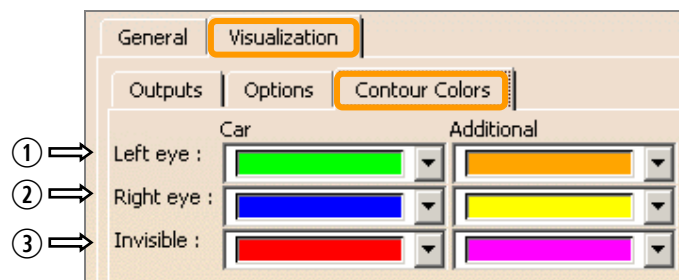
The calculated contours will be displayed on the geometry that is selected on the tab card *Additional Geometry*.

④ Target Plane Max Size

Here you have to define the size of the target plane. The extension is two dimensional, starting from the eye point respectively half of the value in positive and negative coordinate direction.

Contour colors

On this tab card you can define colors for the visualization of the calculated contours for the vehicle geometry and the additional geometry.



① Left eye

Color for the visualization of the contours for the left eye.

② Right eye

Color for the visualization of the contours for the right eye.

③ Invisible

Color for the visualization of the contours for the non visible areas.



The check for the ambinoocular view requires the calculation of contours in several steps (left eye, right eye and generally non visible areas for both eyes). The computation for the ambinoocular view will take much more time than for the monocular view.



If you define the vehicle's windows as outside covering geometry you will have to select as general covering geometry only those who are blocking the view more than the selected outside covering geometry will do. So it is possible to limit the number of selected geometry what has a positive effect on the computing time.



Due to performance reasons the calculation method is based on tessellation even if the input geometry is a surface (for CGR geometry as well). The calculated curves on the geometry are therefore not as smooth as they would be using a V5 reflect curve.

13. Close Range Visibility



The new Japanese visibility law (MLIT Announcement 619/2002 Att.81) requires the visibility of an „obstacle“ for the driver by direct view or by using a mirror or other optical systems. The obstacle, which is defined as a cylinder with a height of 1 m and a diameter of 0,3 m, must be visible (even partly) in a defined range in front of and beside the driver.

Procedure of the test

Outgoing from an eye point or one of the extended eye points the visibility of an obstacle is calculated by moving the cylinder around the car geometry in discrete steps on a given positioning curve. For each of these steps it is checked whether the obstacle can be seen by the standard eye (or left/right eye) or one of the extended eye points, or not. If it is not directly visible the check is extended by using a defined mirror or camera system. At the edge of the visible to non visible area the moving steps of the cylinder are iteratively minimized to detect the boundary as exact as possible. The blind areas are visualized as a cylindrical volume as geometry with sight rays to the extreme points. This is done by settings on the tab card *Visualization*. The non visible but valid and non visible and invalid areas can be visualized by different colours. So a drawing derivation can be done easily with V5 methodology.

The obstacle can optionally be positioned as Demo Cylinder at a defined position on the guiding curve. At least one sight ray to the cylinder can be visualized. Depending on the state of visibility the cylinder is visualized in different colours (e.g. red/green). The colours can be defined by the user in the tab card *Visualization*.

If the result of the calculation contains one or more invalid invisible area the invalid icon is shown in the V5 feature tree.

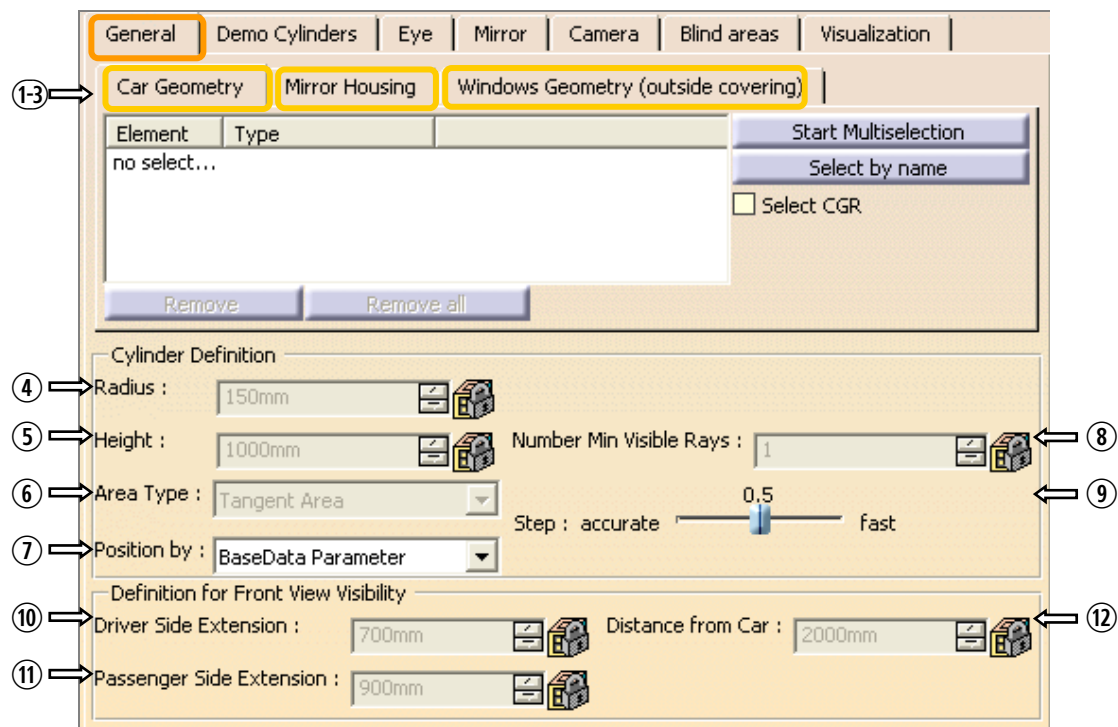
Description of the functionality

The function will be started over an icon from the Vision-toolbar of the CAVA Workbench. The Feature provides the calculation of the direct and indirect view to the obstacle.

The feature is created in the actual geometrical set and can simply be edited by a double click on the feature tree entry.

The fact if the vehicle is left or right driven will be read from the CAVA base data.

- „General“ tab card



- ①-③ Geometry selection

The visibility of the cylinder is checked according to the selected car geometry. There is no need to define the A-pillar geometry separately as it is mentioned in the standard document (A-Point, intersection with plane etc.)

CAVA does not consider the wiper and steering wheel geometry separately. That means that the user should not select one of this geometry in the car geometry selection list. Doing it that way, the geometry will not be considered for the calculation at all.

- „Car Geometry“ tab card

The contour of the checked area (contact to cylinder or tangent area, see below) is based on the selected geometry. It is calculated according to road level and the height of the obstacle (cylinder)

- „Mirror Housing“ tab card

The mirror housing can be selected separately to define the outline of the vehicle contour without the mirror.

- „Outside Geometry“ tab card

This means all window geometry and all non view blocking geometry.

Cylinder Definition

④ Spinner „Radius“

Radius of the cylinder that is given from the standard. This value can only be edited in *Free* mode.

⑤ Spinner „Height“

Height of the cylinder that is given by the standard. This value can only be edited in *Free* mode.

⑥ Area Type

The text in the close range visibility standard allows different interpretation of the area definition. In general there are two different procedures for the positioning of the obstacle around the vehicle.

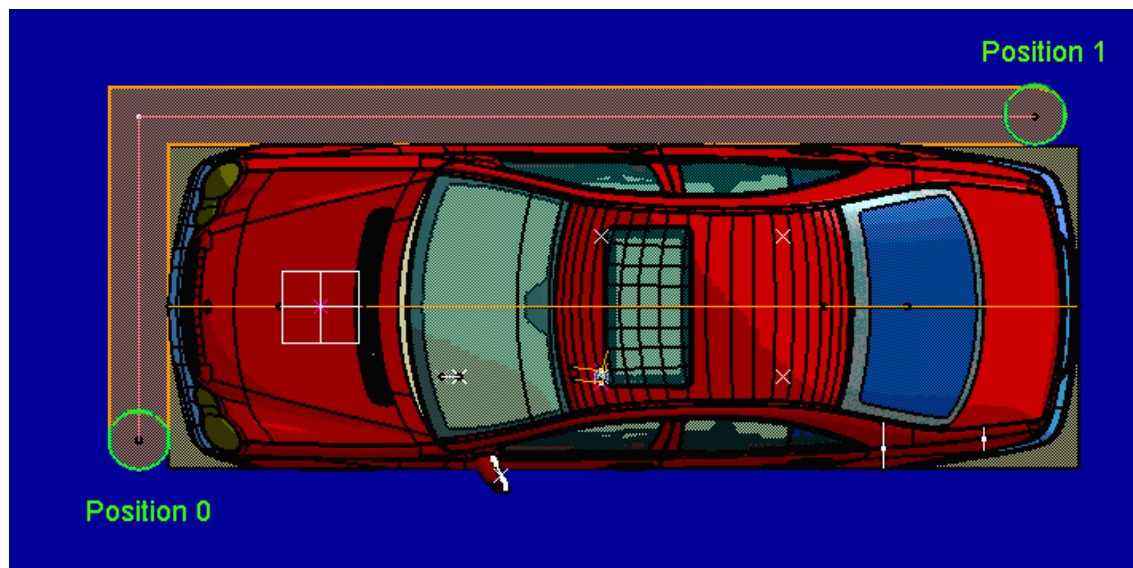
In standard mode the area selection is driven by the selected standard. If you select the standard MLIT 619/2002 Att.81 the area type is *“Tangent Area”*, for the Standard MLIT 619/2002 Att.81 (car contact) the area type is *“Contact of cylinder”* and for the MLIT 619/2002 Att.29 the area type is *“Front View”*

In *Free* mode you can select one of this on your own.

• Tangent area:

The check area in which the obstacle has to be placed is defined by the car and two vertical planes. One of them is placed in front of the car 0,3 m from the front most point of the vehicle geometry and the other is placed 0,3 m from the most outer right sided vehicle geometry (W103)

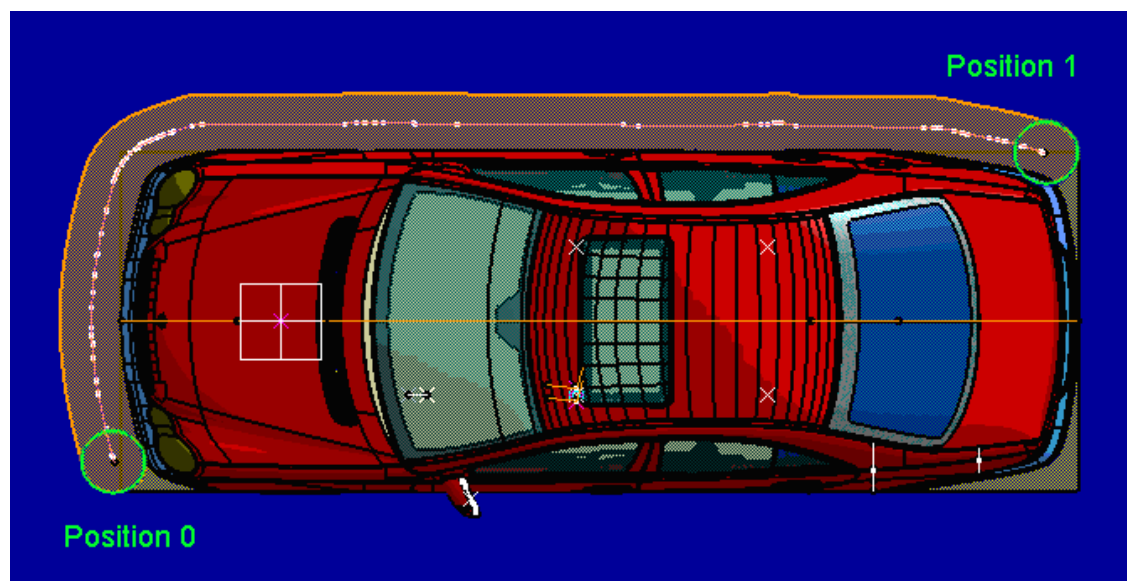
(Right driven vehicle: From the surface of the left vehicle side.)



The measurements of the check area (extension to the front, extension to the side) and the obstacle (Height, diameter) are defined in the CRV configuration file. Under some circumstances it would be possible to check also the truck's close range visibility that uses a larger check area.

Contact of Cylinder

Different to the tangent area (Lform) method, the cylinder is placed to the vehicle geometry contour (except the mirror contour if the bottom of the mirror housing is less than 1 m to the road plane).

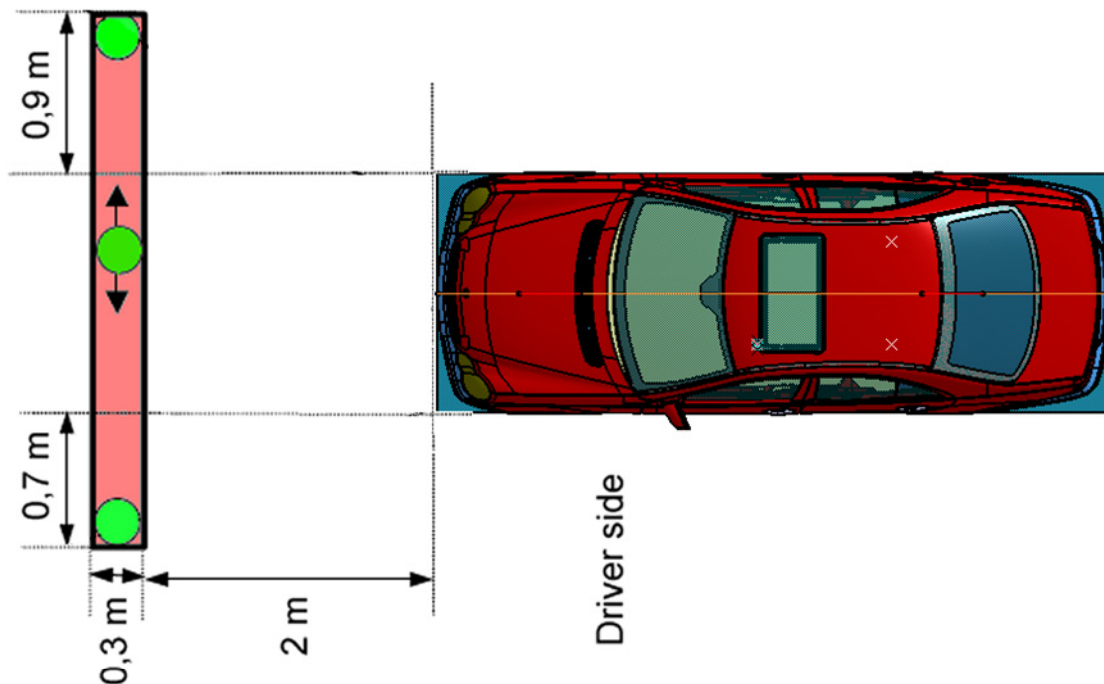


Front View

With an obstacle positioned within the space enclosed between a vertical plane 2m away and another vertical plane 2.3m away, respectively, from the front of the vehicle which is in the test vehicle state, and at the same time enclosed between a vertical plane 0.9m away from the left side surface of the vehicle (for a vehicle whose steering wheel is installed on the left side, the right side surface of the vehicle is applicable) and another vertical plane 0.7m away from the right side surface of the vehicle (see fig. below), directly confirm the obstacle from the reference eye point.

At least part of the obstacle shall be visible. However, in case such confirmation is disturbed by any blind spot created by the A-pillar, wipers, or the steering wheel, the aforementioned criterion is not applicable.

The calculation or checking is a little bit different from the other two area types (tangent area/contact of cylinder). In the "Front View area" check there are no blind spot areas allowed. So the result will only be "Ok" (cylinder color = green) or "Faulty" (cylinder color = red) but no orange one.



⑦ Position by

For the standards MLIT 619/2002 Att.81 and MLIT 619/2002 Att.29 this selection box allows you to use either the vehicle geometry or the base data parameter to define the outline of the vehicle. If you have selected the base data parameter option you will not have to specify geometry in the element list of the “car geometry”.

Especially for the area type “Front View” it makes sense to use optionally the car width and length that are defined in the base data for positioning of the cylinder trace.

Close Range Visibility features that were created with a CAVA version older than 1.8.3 will always use the “Use geometry” option, but the user can change it for the tangent area.

⑧ Spinner „Number Min.Visible Rays“

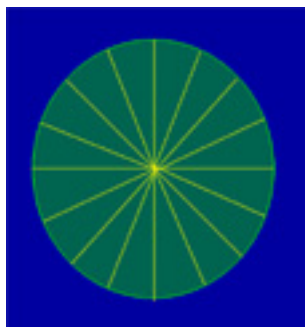
Defines the minimum amount of sight rays that has to be visible. This means the number of sight rays that have to be visible to declare the cylinder as visible.

⑨ Slider „Step“

You can use this slider to adjust the accuracy of calculation. Select a value between 0 (accurate) and 1 (fast).

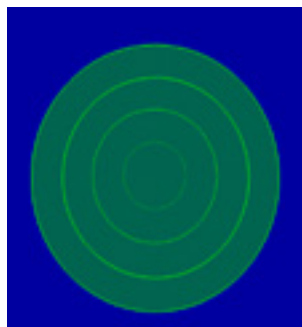
This value defines the number of calculated points on the cylinder and the step width between two cylinder positions. This value replaces the parameters for the number of points on the cylinder as they were used in a former CAVA version.

CAVA creates on the cylinder the following points:



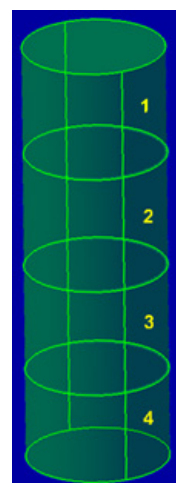
Number of angular segments

The cylinder is split to several angle segments to make the calculation more accurate.



Number of radial segments

The cylinder is split to several segments in radial direction.



Number of vertical segments

Segmentation of the cylinders height.

Definition for Front View Visibility

These values are given by the standard and can only be changed in “Free” mode

⑩ Driver Side Extension

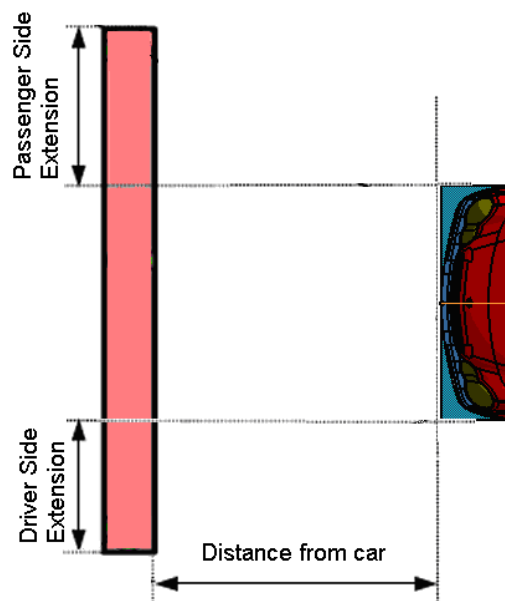
Distance between the outer most vehicle geometry at the driver side and a vertical plane.

⑪ Passenger Side Extension

Distance between the outer most vehicle geometry at the passenger side and a vertical plane.

⑫ Distance from car

This is the distance between the outer most frontal geometry of the car and a vertical plane in front of the car





If you select to perform the check with less accuracy but with faster computation time the application will check just a small number of points for visibility on the cylinder and the cylinder is moved by bigger steps. In general it could happen that the cylinder is not visible in certain positions. In general, if the standard is satisfied using the calculation setting “less accuracy/fast computation” it will be also satisfied for the calculation with more accuracy and less computation time.



If you define the vehicle’s windows as outside covering geometry you will have to select as general covering geometry only those who are blocking the view more than the selected outside covering geometry will do. So it is possible to limit the number of selected geometry what has a positive effect on the computing time.

• Demo Cylinder tab card

Name	Position (0...1)	Type	Show	Show ray
Demo Cylinder.1	0	Simple	1	1
Demo Cylinder.2	0,3	Detailed	1	1
Demo Cylinder.3	0,7	Detailed	1	1

Position (0...1) : ☐ Show demo cylinder

Type : ☐ Show demo cylinder ray

① List Demo Cylinders

The list elements will be defined by the fields and options ②-⑤ and by using the buttons ⑥-⑨.

The name of the demo cylinders are given from the application.

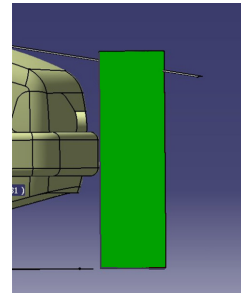
② Demo position (0...1)

Position of the demo-cylinder in the check area. The range of the values is from 0 to 1. Value 0 indicates the first possible position at the vehicles front (start position) and a value of 1 the last possible position at the side (end position) (see figure below). Each value between these two end points indicates a discrete position on the cylinder’s path around the vehicle geometry.

③ Type

Simple:

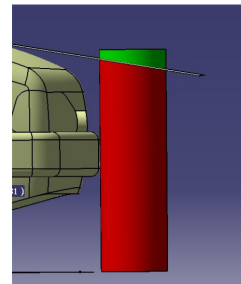
The simple visualization creates the demo cylinder complete in one color (using the colors defined above according to the visibility – see fig. to the right).



Detailed:

This visualization type created the visible and the non visible part of the demo cylinder in the respective colors, defined above (see fig. to the right).

Note: The color definition for the visible and non visible area will be done in the „*Visualization*“ tab page.



④ Show demo cylinder

Use this option to make the demo cylinder visible or not.

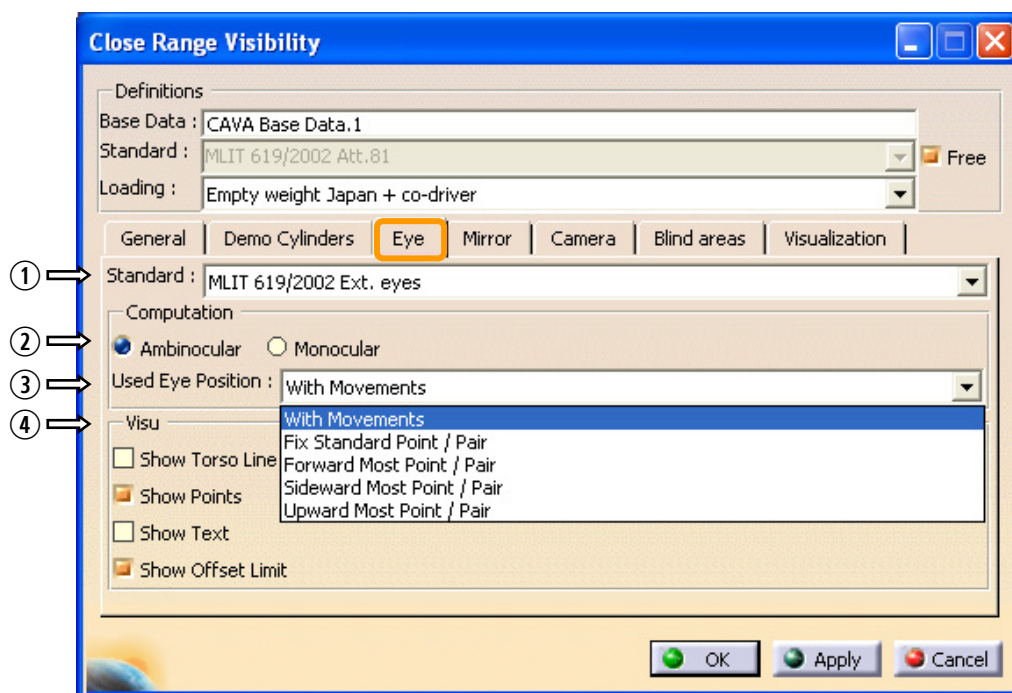
⑤ Show demo cylinder ray

This option creates sight rays to the demo cylinder starting from the (extended) eye points. The number of rays can be defined on the tab card „*General/Cylinder Definition*“ in the field „*Number Min Visible Rays*“. If the number is set to one (default value), the sight ray will be positioned to the mid point of the cylinders top surface. The position of other rays is depending on the segmentation of the cylinder.

⑥-9 List control buttons

Use these buttons to manage the list entries.

- Eye tab card



① Standard

Selection of the eye point standard.

The eye points, used in this feature differ from the one that are used in the other CAVA features.

The *Standard-Eye point* is located 635 mm vertical above the SgRP for a torso angle of 25 deg. If the torso angle is not 25 deg the values of the table below will be taken into account. (The values are according to 77/649/EWG, Table IV).

Back Angle (°)	Adjusted Distance (mm)		Back Angle (°)	Adjusted Distance (mm)	
	Front (-) Back (+)	Up (+) Down (-)		Front (-) Back (+)	Up (+) Down (-)
20	-44	11	25	0	0
21	-35	9	26	9	-3
22	-26	7	27	17	-5
23	-18	5	28	26	-8
24	-9	3	29	34	-11

The eye points (ambinocular sight) are located 32,5mm from the standard-eye point (the x - and z -coordinate remain the same).

In difference to the existing eye point feature an additional translation distance is considered to take into account a possible dilation of the drivers head.

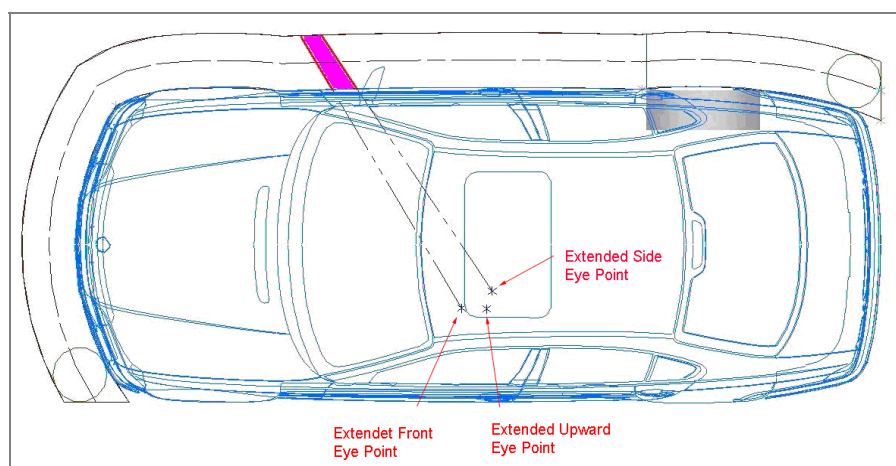
If the obstacles are not visible from the standard-eye points or the permitted obstruction is to big the so called „*Extended Eye Points*“ will be used instead.

The adjustment can be forward/backward, to the left/right or up/down and must lie into the limits for the adjustment distance according to table below. The reference eye point is considered as base points.

[mm]	Adjustment limits for-/backwards (+ backwards; –forwards)	Adjustment limits right/left (+ right; – left)	Adjustment limits top/down (+ top; – down)
Base eye point	0	0	0
Eye point using dilation to top	0	–10	40
Eye point using dilation to the front	–140	–15	10
Eye point using dilation to the side	30	–110	15

Table: Limits for the adjustment of the eye point.

Remark: The table is valid for right driven vehicles. For left driven vehicles replace „right“ by „left“ and „left“ by „right“.



An overlapping of dilations is not possible. This means that the movement for the dilation can be only to one direction. So to say only “*to the front*” or only “*to the top*” or only “*to the right*”; but not “*to the front and to the right and to the top*”.

CAVA is calculation the dilation of the eye points at the maximum value. According to the standard there are also interim values allowed (the eye point is just partially moved), but it is not used in practice.

To determine the optimal sight to the obstacle it is allowed to use “totals” of the eye points (*best-case*). For example you can determine the frontal sight limit by using the “*Extended Front Eye Point*” and the rear sight limit by using the “*Extended Side Eye Point*”.

Because the functionality (slightly) differs from the CAVA-Manikin eye point feature, an additional eye point feature is created to cover the all required functionality. This is integrated as sub feature of the close range visibility feature.

The second standard uses the standard eyes without the movement to the front or side.

② Calculation

- *Ambinocular*:

The ambinocular sight is used for the calculation. This means that the eye points are each 32,5 mm away from the standard-eye point (*x* and *z* coordinates remain the same).

- *Monocular*:

The monocular sight is used for the calculation. This means that the standard eye points used for the calculation.

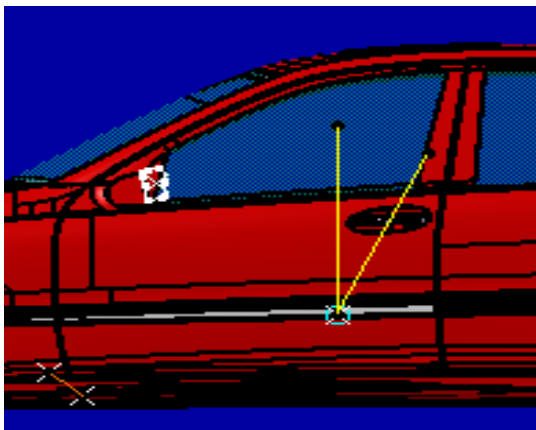
③ Used Eye Position (only enabled in *Free* mode)

This option enables you to define the position for the extended eye points.

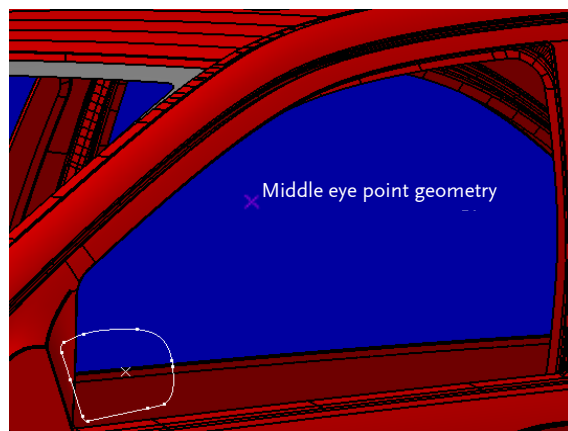
- with movements: This is the default setting that uses the movements to the outer most positions.
- Fix standard point/pair: This setting uses the standard eye points at a fix position.
- Forward most point/pair: This setting uses the most forward eye points at a fix position.
- Sideward most point/pair: This setting uses the most sideward eye points at a fix position.
- Upward most point/pair: This setting uses the most upward eye points at a fix position.

④ „Visu” option button

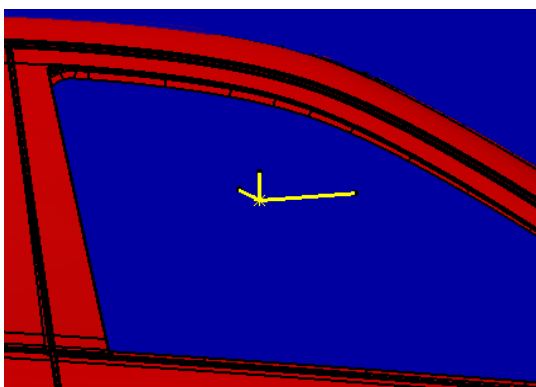
- Show Torso Line



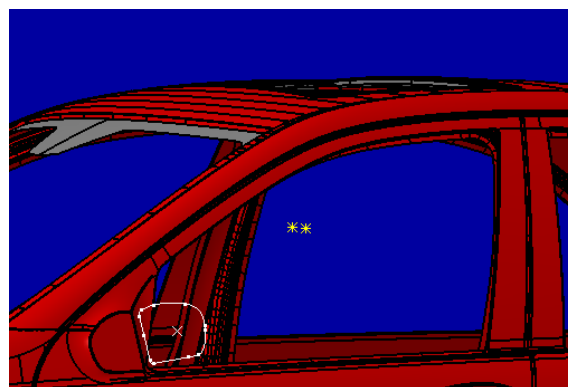
- Show Text



- Show Offset Limit



- Show Points



Starting from the base-eye points the dilation to the top (0, -10, 40), to the front (-14, -15, 10) and to the side (30, -11, 15) is shown as line.

The obstacle can either be seen from the standard- or extended eye point) or with a help of a mirror and/or other equipment according to Article 44 par. 5 of the safety rules.

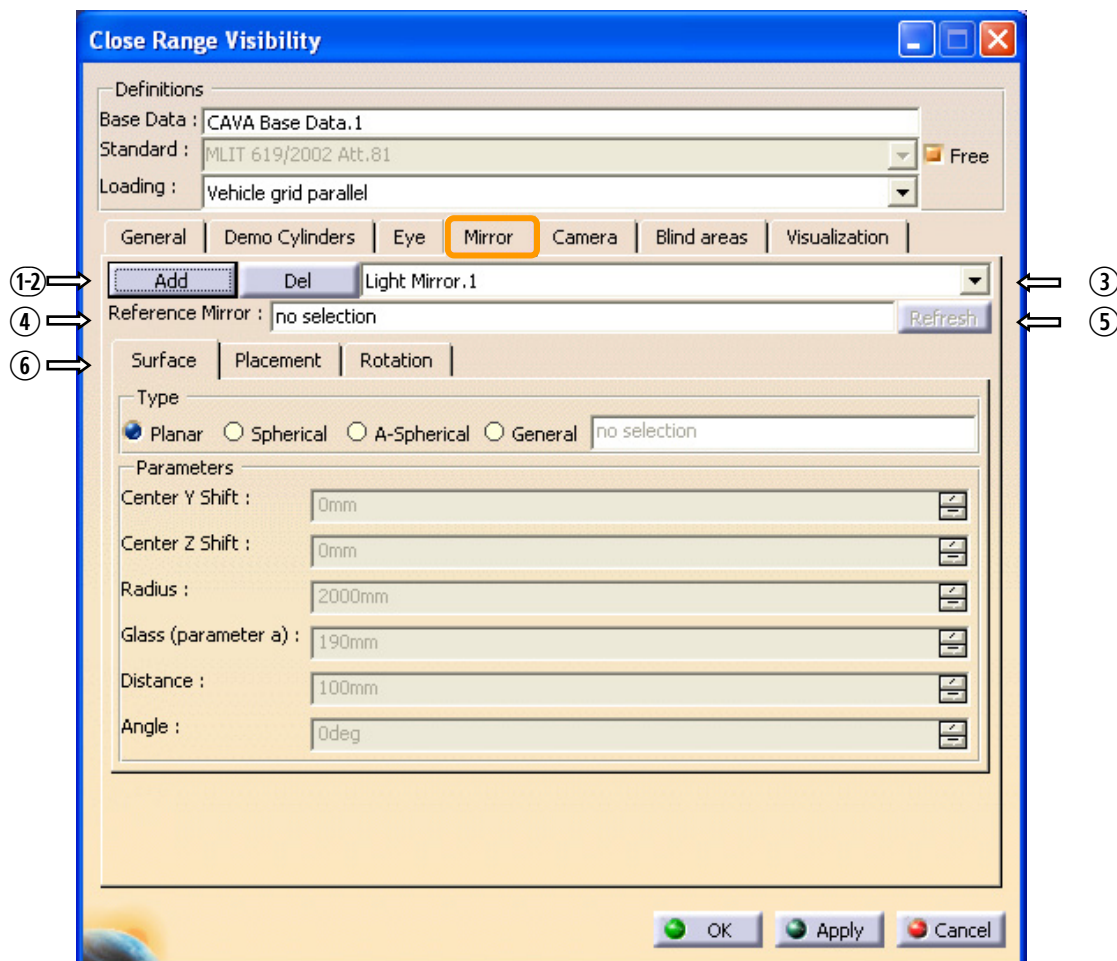
CAVA provides the possibility to define additional mirrors as well as camera systems that are considered in the calculation of the close range visibility.

- **Mirror tab card**

In the dialogue it is possible to define several mirrors.

The definition of the mirror is done by the rotation point, the contour, the type (plan/spherical/aspherical) with the corresponding parameters as well as rotation angle (analogue to the common CAVA-Mirror feature).

The used mirrors are created separately in the „close range visibility“-feature. If an existing CAVA-Mirror feature is referenced as additional mirror the appropriate data will be read from the CAVA-Mirror-feature and then put to a discrete „close range visibility“-feature. The data is no more associatively linked.



① Add

Adds a new mirror element to the list in field ③.

② Delete

Removes the selected element from the list of additional mirrors in field ③.

③ Mirrors

This list contains all defined additional mirrors. They can be administrated by using the buttons *Add* ① and *Delete* ②. The parameters of the selected additional mirror are defined in the fields of the tab cards „*Surface*“, „*Placement*“ and „*Rotation*“.

④ Reference Mirror

An existing CAVA-Mirror feature can be used for the calculation. If an existing CAVA-Mirror-features is referenced as additional mirror the appropriate data will be read from the CAVA-Mirror-feature and then put to a discrete „close range visibility“ feature. The data is no more associatively linked.

⑤ Refresh

If an existing CAVA Mirror-feature is referenced in field ④ the data of the CAVA-Mirror feature is imported to the close range visibility dialog by pressing the „*Refresh*“ button. The parameters of the referenced mirror are now in the tab cards „*Surface*“, „*Placement*“ and „*Rotation*“.



Important: If you forget to press the „*Refresh*“ button after referencing a CAVA-Mirror feature the calculation of the close range visibility is done without the referenced mirror.

⑥ In the tab cards „*Surface*“, „*Placement*“ and „*Rotation*“ you have to declare all the parameters, that are necessary for the definition of the additional mirror.

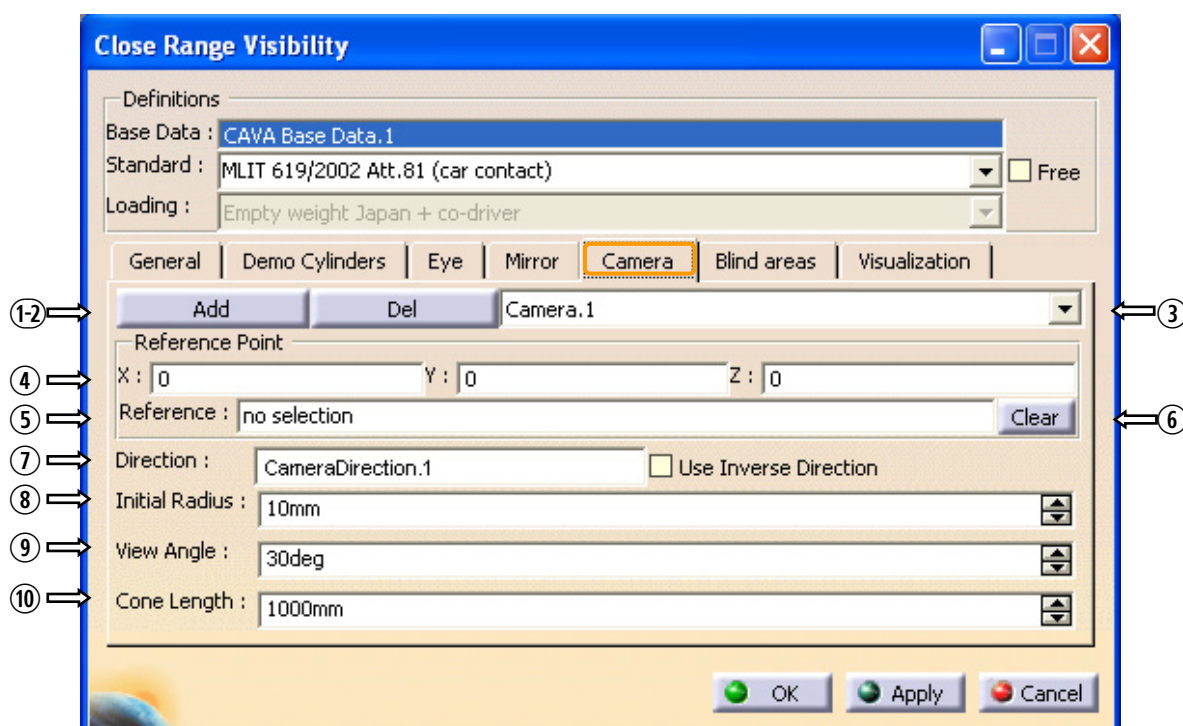
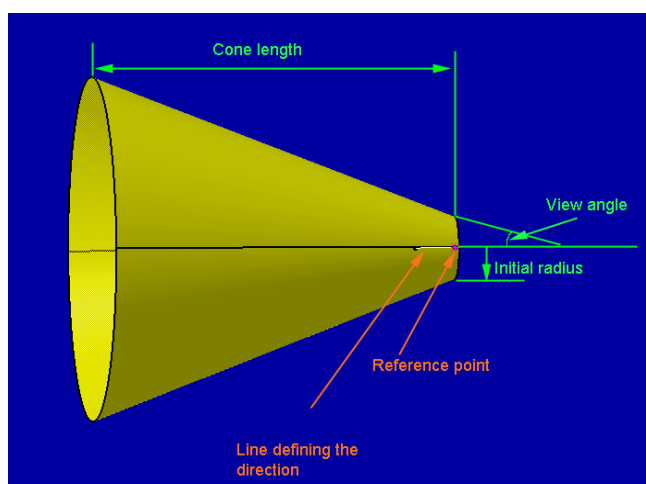
If you have referenced an existing CAVA Mirror-feature in field ④ the parameters are automatically put to the fields in the tab cards after you have pressed the *Refresh* button.

For the description of the fields in the tab cards please refer to chapter 3 *Rear View Mirror* on page 10.

• **Camera tab card**

Beside the additional mirrors it is also possible to define several camera systems. The camera is defined by a V5-Point, a line indicating the direction, an initial radius and a view angle.

With these parameters some kind of vision cone is created that represents the visible area of the camera system—see figure to the right.



① Add

Adds a new element to the list of camera systems in field ③.

② Delete

Removes the selected camera from the list in field ③.

③ List of the Cameras

This list contains all defined camera systems. They can be administrated by using the buttons *Add* ① and *delete* ②. The corresponding parameters for the selected camera are defined in the fields ④-⑩.

④ Reference point

Here you can define discrete values for the Coordinates of a point that defines where to place the camera.

⑤ Reference

Alternatively to the definition by discrete coordinates (④), it is possible to reference an existing V5 from the model.

⑥ Clear

Removes the referenced point from the field. If you want to use only coordinates to define the point you have to be aware that the field for the referenced point is empty. Otherwise CAVA uses the referenced point and the coordinates together for the calculation.

⑦ Direction / Use Inverse Direction

Select a line to define the direction of the sight rays for the camera.

If the orientation of the selected line points to the opposite view direction you will have to activate the *Use Inverse Direction* button.

⑧ Initial Radius

Radius of the vision cone at the starting point (Reference point ④/⑤).

⑨ View Angle

View angle of the vision cone for the camera (see figure above).

⑩ Cone Length

This value defines the length of the vision cone or vision area of the camera. Obstacles that lie in the cone direction, but that are not inside the limits for the defined cone length, will not be considered in the calculation.

• **Blind Areas tab card**



This output is only for the area types “tangent area” and “contact of cylinder”. In the “Front View area” check there are no blind spot areas allowed.)

Determining the limits for the obstruction of view:

The blind area ends if one part of the cylinder can be seen.

The permitted obstruction is calculated according to the following formula:

$$X \leq 0,292 L - 203 \text{ [mm]}$$

with:

X—distance from mid point to mid point of the obstructed cylinders.

L —distance from the trailing edge of the rear obstructed cylinder to the leading edge of the rear wheel (diameter).

If there exist more than one blind spot area the formula has to be applied to all of them.

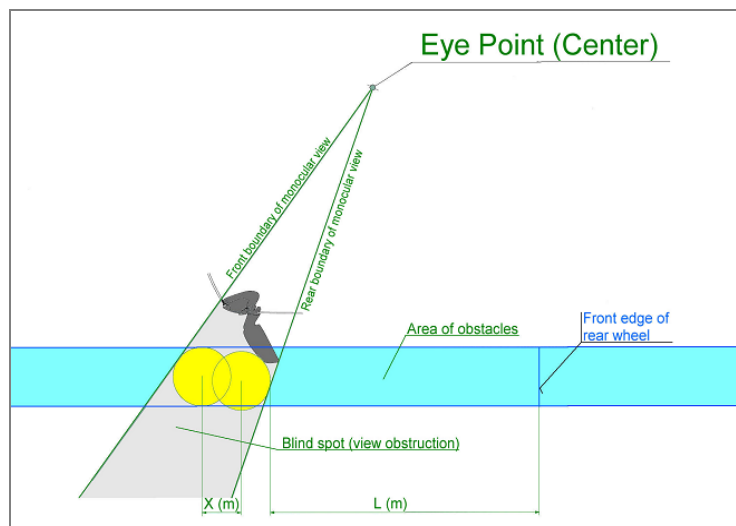
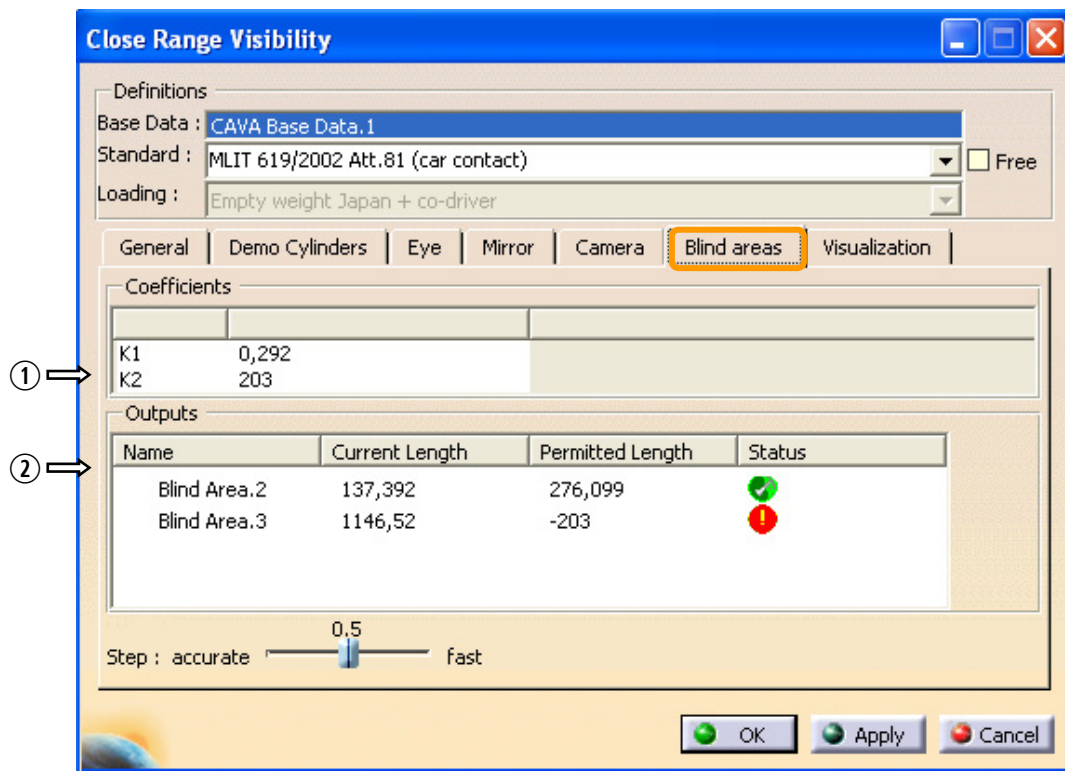


Fig.: Example for the determination of the permitted blind spot area for monocular sight (Illustration for right driven vehicle).



① Coefficients

Coefficients for the formula to calculate the permitted blind spot area.



$$X \leq K1 \cdot L - K2 \text{ [mm]}$$

These values are taken from the configuration file and cannot be edited by the user.

② Outputs

This list contains the calculated blind spot areas.

- Name Name of the blind spot area (is defined by CAVA).
- Actual length Calculated length of the blind spot area.
- Permitted length This length is calculated according to the formula:

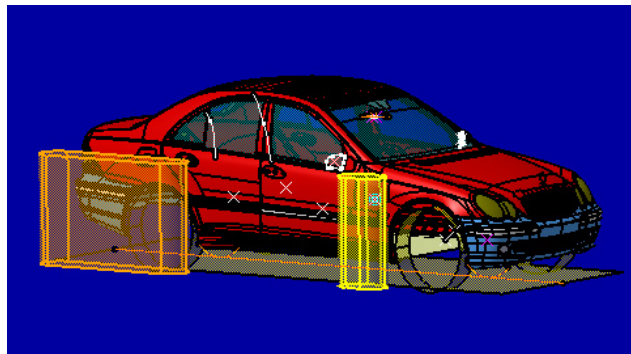
$$X \leq 0,292 \cdot L - 203 \text{ [mm]}$$
- State
 -  The green check symbol indicates that the blind spot area is inside the permitted limits.
 -  The red symbol with the exclamation mark indicates that the blind spot area is outside (larger) the permitted limits.

③ Slider „Step“

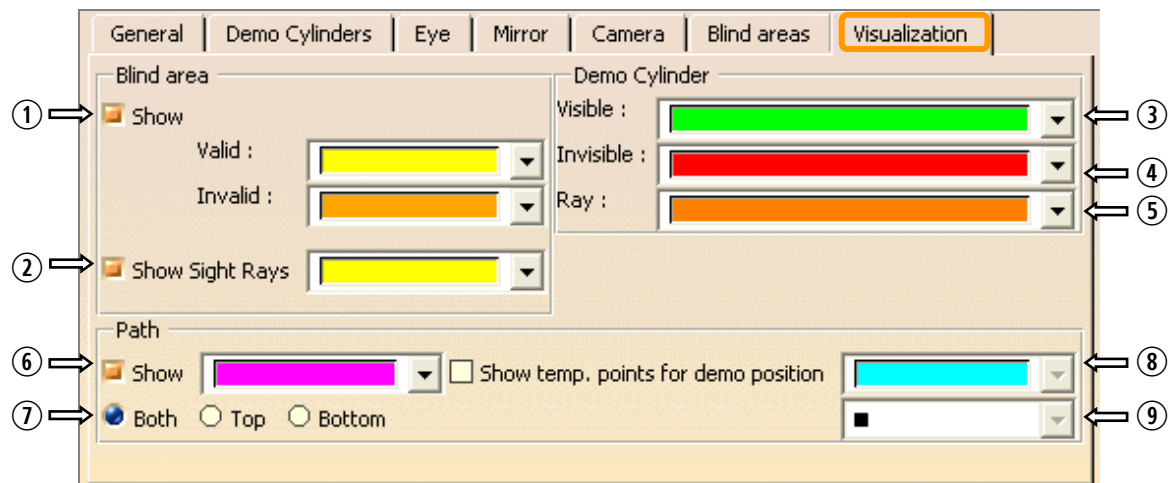
You can use this slider to adjust the accuracy of calculation for the determination of the view covering areas. Select a value between 0 (accurate) and 1 (fast).

The calculated areas are visualized as volumes in the CATIA-workspace. In the figure to the right for example, the orange colored area indicates that the blind spot area is beyond the permitted limits. The yellow volume indicates a blind spot area that is inside the permitted limits.

(The colors can be defined in the tab card „Visualization“.)



- **Visualization** tab card



Blind spot area

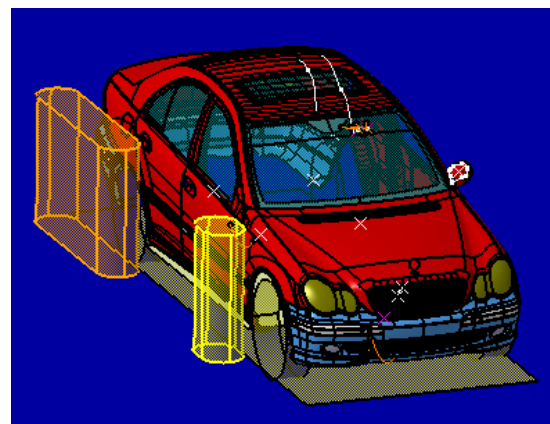
① Show

- Valid

Select a color for the visualization of the valid blind spot areas. These areas are obstructed by view but they are inside the permitted limits that is calculated by the formula

$$X \leq 0,292 L - 203 \text{ [mm]}$$

(yellow area in the fig. to the right).



- Invalid

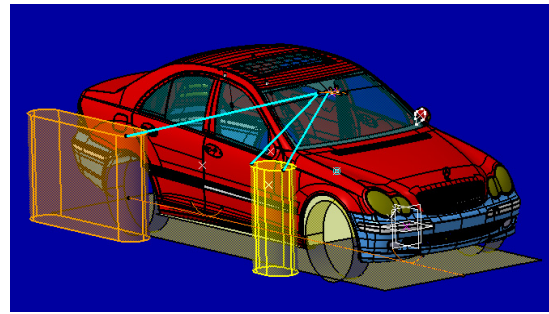
Select a color for the visualization of the valid blind spot areas. outside the permitted limits that is calculated by the formula

$$X \leq 0,292 L - 203 \text{ [mm]}$$

(Orange colored in the fig. to the right)

② Show Sight Rays

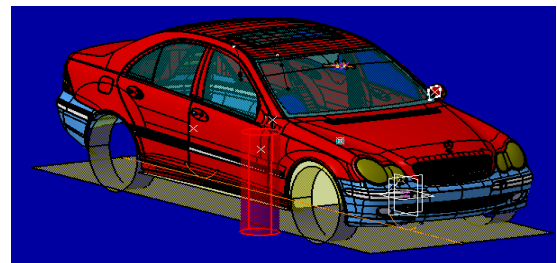
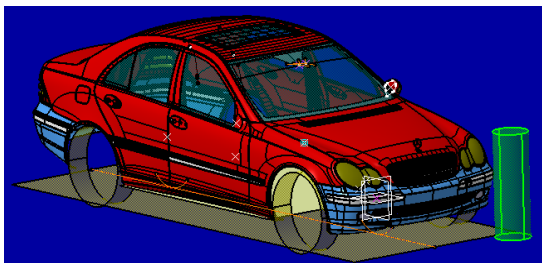
If this option creates sight rays to the cylindrical volume of the blind spot area, starting from the used (extended) eye points. For each cylindrical volume there will be one ray to the first visible point and one to the last visible point.



Demo Cylinder

③④ Visible/Invisible

The cylinder can be visualized in different colors depending on its visibility state (see figure below). The colors for the state (visible/invisible) can be defined here



⑤ Ray

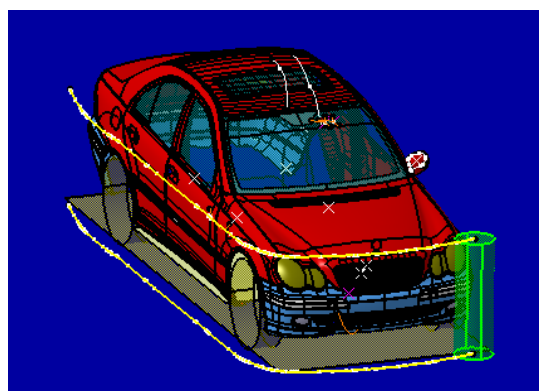
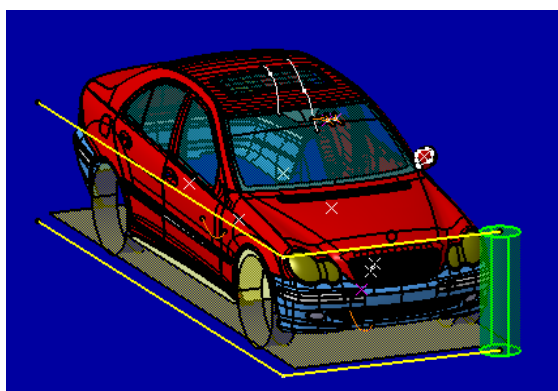
Select a color for the visualisation of the sight rays.

You will find the option to switch the visibility of the sight rays on or off in the „Demo Cylinder“ tab card.

Path

③ Show

This option visualizes the path of the cylinder midpoint around the vehicle geometry that is selected in the tab card „General/Car Geometry“. The type of visualization depends on the selected area type (tangent/contact of cylinder) on the tab card „General/ Cylinder Definition“.

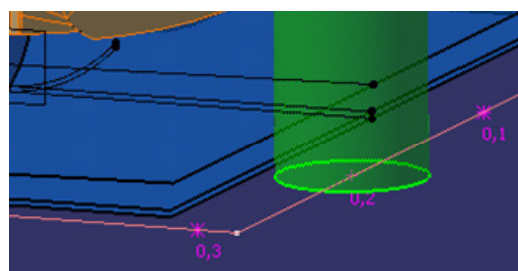


- ④
- Top The path is visualized on the level of the top most cylinder boundary.
 - Bottom The path is visualized on the road plane.
 - Both The path is visualized on the level of the top most cylinder boundary and on the road plane.

(These options will only be available if the option *Show* ③ is active)

- ⑦ Show temp. points for demo position

Activate this option to visualize the mid points of the demo cylinder on its path around the vehicle. The points are created in a step of 0,1 m. The value is labeled beside the point.



Type of point

Here you can define the type of point that is used to visualize the cylinder path on the ground.

* * *