CATIA V5 Automotive Extensions Vehicle Architecture — OVA (CO9)

User Guide

BPA Delivery 7 for V5R19 (V 5.7)

Instruction symbols used in this guide

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

Warning triangle

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

Hint symbol

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

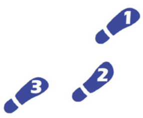
Note symbol

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

Information symbol

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

Work steps symbol



The work steps symbol
relates to a
step-by-step instruction sheet.

Table of Contents

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0. CAVA in General

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

Product + Description	Functions
OVA	
OVERALL VEHICLE ARCHITECTURE Car base data, positioning and parameters of car components, ground clearance • CAVA base data General data of the vehicle defining its skeletal structure that are used for the most of the CAVA functions. Once the base data is specified in CAVA OVA, it will be available consistently for all CAVA functions. In the base-data dialog the different loadings are specified. Detailed description see CAVA OVA User Manual.	CAVA BASE DATA CAVA base-data data base CAVA SLOPE ANGLE CAVA STATIC CURB CAVA DYNAMIC CURB CAVA GROUND CLEARANCE CAVA INNER ANGLE CAVA OIL PAN CAVA WHEEL FIXING CAVA UNDERFLOOR COMPLETE CAVA LAMPS CAVA NUMBER PLATES CAVA BUMBERS CAVA-CRASH-BARRIEREN CAVA WHEEL COVERING CAVA SEATING BELTS CAVA CHILD PROTECTION CAVA FREE SPACE TOP TETHER

2. Base Data

Base data are the general data of the vehicle defining its skeletal structure and that are used for the most of the CAVA tools. A part of these data is set by CAVA according to the selected vehicle category (limousine, off-rod car etc.) and the respective standards; other data is to be specified by the user in the CAVA base data dialog—on the *Overall Data*, *Wheels*, *Seats* and *Loadings* tab cards. Which data and how many is to be specified by the user depends on the selected vehicle category. Once these data is specified, it will be available consistently in all CAVA functions. This base data then is used to calculate the different loadings.

In order to compare different vehicles, it is possible to have in one CATIA document several of these skeletal structures.

• Opening the *Base Data* dialog box

The *Base Data* dialog box is accessed:

- When creating the base data:
  after clicking the *OK* button of the *BaseData start* dialog box (see 2.1 *Base Data—Car* Category on page 6);
- when the base data already has been created:
  by double-click on the base-data feature in the specification tree.

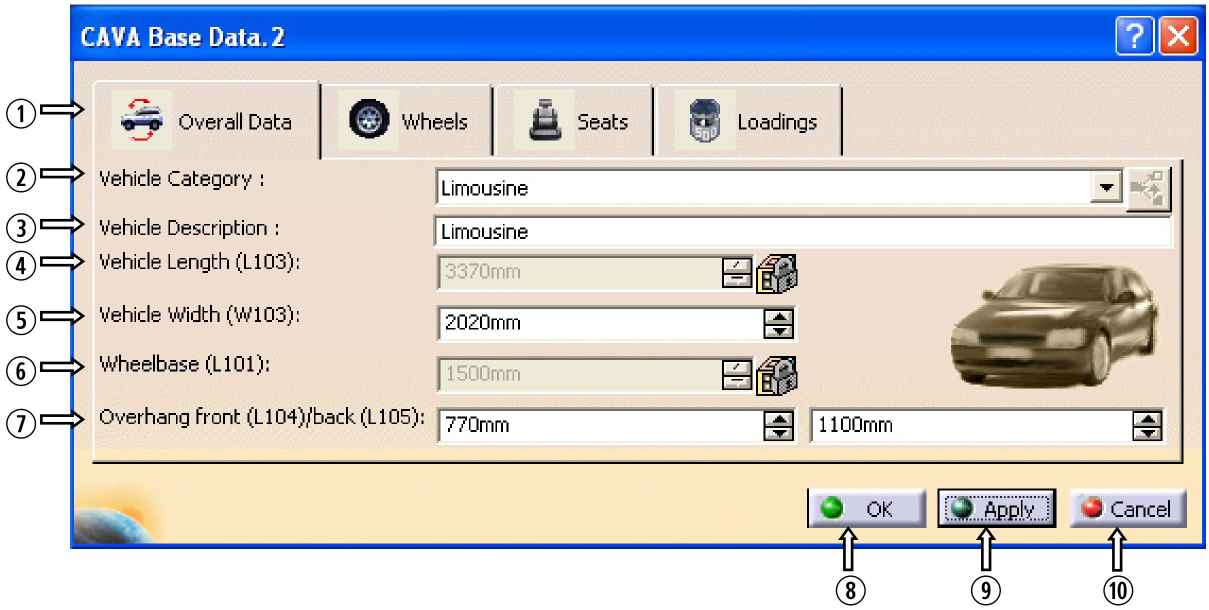
2.1 Base Data—Car Category

Clicking on this icon in OVA toolbar
opens the following dialog box.

Since version 1.12.1 the process for defining vehicle categories has changed. From now on you can change the vehicle category at any time. Please take this in mind in case you are using this user manual with an older CAVA version.

2.2 Overall Data

On the *Overall Data* tab card all parameters are defined, determining the vehicle dimensions.



① *Overall Data* tab card

The *Overall Data* tab card is activated by default after opening the *base-data* dialog box.

② Vehicle Category

Select a vehicle category from the list. This list contains all vehicle categories that are defined in the `BaseData.xml` configuration file.

The selected category affects the feature input values taken from the standard. For example, the standard for Off-Road cars uses calculation methods different from the methods for usual cars (e. g. Limousine). The category also affects which options are available in the user dialogs.

(This field is new since version 1.12.1)

③ *Vehicle Description* text box

Enter a name or short description of the vehicle in this field. This entry is meant to help you, the user, to identify the vehicle. The entry is not displayed in the specification tree and has no effect on the further work with CAVA.

④ *Vehicle Length (L103)* spinner box

Vehicle Length is a computed value and cannot be changed by the user (this is symbolized by the padlock). The underlying formula calculates vehicle length based on wheel base plus front and back overhang.

⑤ *Vehicle Width (W103)* spinner box

The vehicle width is calculated outgoing from the vehicle mid plane half of the defined value in positive *y* direction and as well half of the defined value in negative *y* direction.

⑥ *Wheel Base (L101)* spinner box

Wheel base is a computed value and cannot be changed by the user (this is symbolized by the padlock). The underlying formula calculates wheel base based on the *x* coordinate of the rear wheel center point minus the *x* coordinate of the front wheel center point.

⑦ Overhang Front (L104) spinner box

The front overhang, measured from the front wheel center point in the negative *x* direction.

Overhang Back (L105)

The rear overhang, measured from the rear wheel center point in the positive *x* direction.

- **CAVA standard buttons**

⑦ 

Adopting the changes and closing the dialog box.

⑧ 

Adopting temporarily the input data for preview.
Final adoption of the data will be effected after clicking *OK* button.

⑨ 

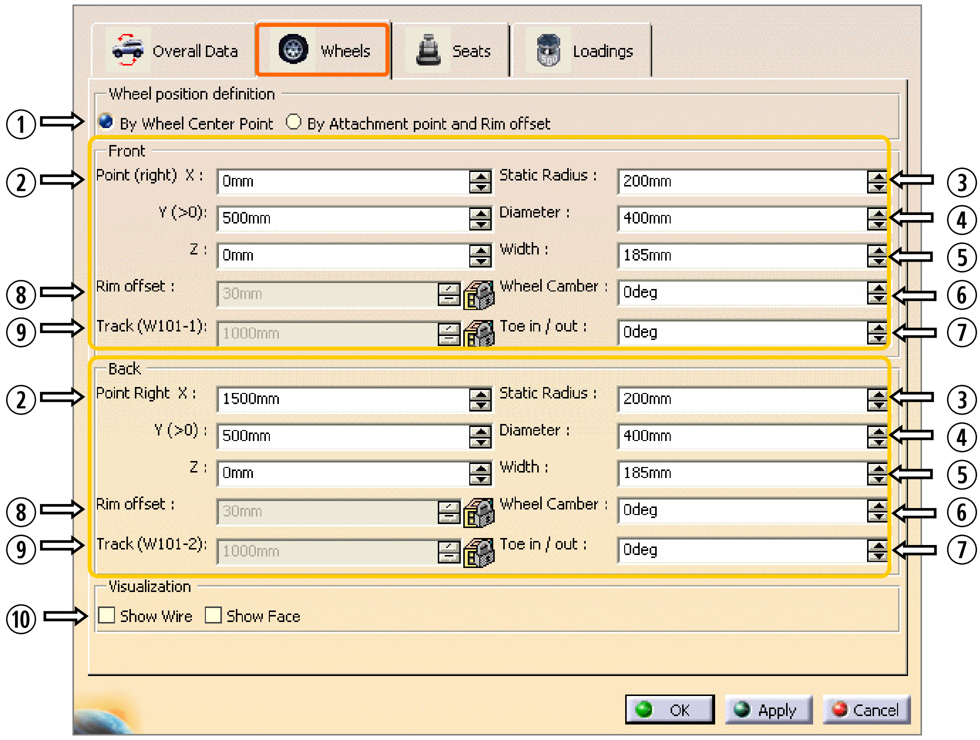
Closing the dialog box. All input data made will be discarded.

– 

Pressing this button results in publishing the features generated with the respective CAVA function.

2.3 Wheels

On the *Wheels* tab card all important parameters of the wheels and tires are defined as the base for determining the chassis frame dimensions.



- **Front and Back**

The boxes in the *Front* section and the *Back* section are the same; in the *Front* section the specifications are made for the front wheels, in the *Back* section—those for the back wheels.

① Wheel position definition

There are currently two ways to define the wheel position.

- "By Wheel Center Point"
  This means you have to define the center coordinates for the wheel.
- "By Attachment Point and Rim offset"
  Often the wheel position point is not directly given from the design, because the wheel is mounted at the axis not in the wheel center but in a point slightly shifted. Together with a "Rim offset" the wheel center can be easily retrieved.

This "Rim offset" defines how to calculate the wheel center from the axis limit point. The axis limit point is translated into the axis direction (using toe in/out and wheel camber) by the value of the rim offset.

② Point (right)

If you have selected the option "By Wheel Center Point" you have to enter the center coordinates (x; y; z) for the right wheel.

If you have selected the option "By Attachment Point and Rim offset" you have to enter the attachment point of the wheel at the axis.

The left wheel will be located symmetrically relatively to the vehicle centerline.

③ Static Radius

Specify the static radius of the wheel.

④ Diameter

Specify the nominal diameter of the wheel.

⑤ Width

Specify the width of the wheel.

⑥ Wheel Camber

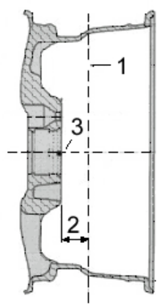
Specify the camber of the wheel.

⑦ Toe-in/out

Specify the alignment of the wheel.

⑧ Rim offset

The rim offset is the shift between the mounting point of the wheel (3) and the wheel center (2).



1 - Rim middle axis
2 - Rim offset
3 - Axis mounting point

⑨ Track

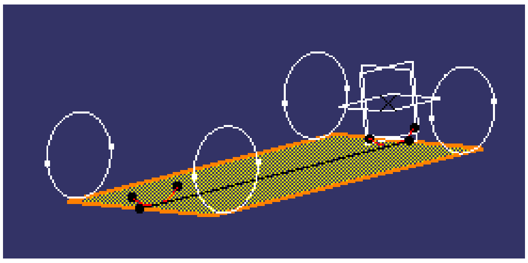
The value is calculated from the y position defined in field ②.

- **Visualization**

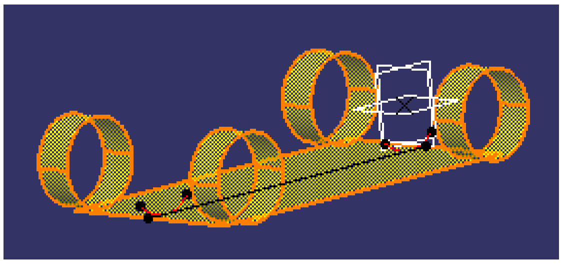
⑩ Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Wire* option*:*
  The features are visualized as wire model.



- *Surface* option
  The features are visualized as surface model.



It is also possible to activate both visualization modes.

Note on the wheel visualization

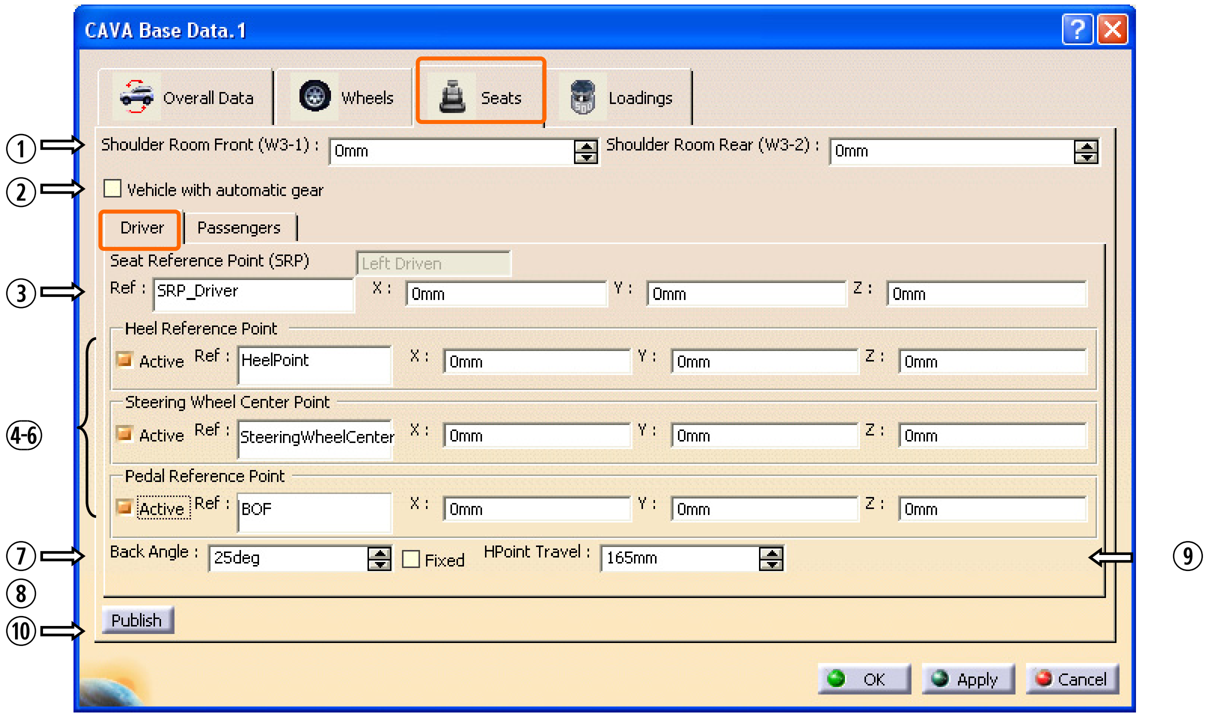
The wheels are visualized on their defined positions on the base of the specified data (wheel camber/track) as wire model or surface model.
Only on the vehicle-grid parallel loading plane the wheels are visualized with their nominal diameter. Here also the static diameter is visualized as circular arc in the vehicle midplane.
On all other loading planes only the static diameter is visualized as circular arc in the vehicle midplane.

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

2.4 Seats

The *Seats* tab defines all important parameters for the seat positions of the vehicle. The tab card has two sub-tab cards—*Driver* and *Passengers.*

The *Passengers* sub-tab card allows to define several seats.



- General part *(upper part)*

① *Shoulder Room Front* (W3-1) spinner box

This information is needed in the calculation for eye ellipses and the head position contour.

Shoulder Room Rear (W3-2) spinner box

This information is needed in the calculation for head position contour.

② *Vehicle with Automatic Gear* check box

Activate this option if the vehicle has an automatic gear. This information is needed for the calculation of the eye ellipses and the head position contour.

⑩ Publish

When this button is pressed, all active seats (driver and passenger seats) will be published.

• *Driver* sub-tab card

③ R*eference point* and *X; Y; Z* text boxes

Define here the seat reference point (SRP). The seat points can be defined in the following ways:

(1) Manual definition of a CAVA seat reference point
To do so, enter in the *x*, *y* and *z* value boxes the required values (absolute coordinates of the respective V5 point).

or

(2) Adoption of a reference point from CATIA
To do so, move the mouse pointer to the text box of the respective CAVA reference point to activate the box; then click on the respective reference point in the CATIA specification tree or on the workspace—after that the reference point will be adopted in the activated text box.
It is possible also in this case to enter values in the *x*, *y* and *z* value boxes. – These values will be interpreted as relative coordinates of the respective CAVA reference point, i. e. relative to the CATIA reference point—the CAVA reference point will be moved in relation to the initial CATIA reference point.

Cancelling the reference on a CATIA reference point

- Activate the *Ref* text box with the mouse pointer.
- Click again on the respective reference point in the CATIA specification tree or in the CATIA workspace. After that in the text box the text “no reference point” will appear.

Left Driven/Right Driven

Shows whether it is a left driven or right driven vehicle. This value is calculated from the driver's seat point coordinates and can not be edited by the user. Y=0 is left driven.

④-⑥
- Heel Reference Point
- Steering-Wheel Center Point
- Pedal Reference Point

Activated Heel Reference Point, steering-wheel center point and pedal reference point are visualized in the model and can be referenced by other CAVA functions (e. g. by 2D MANIKIN TEMPLATE).

- *Active* check box:
  This check box has two functions:
  (1) Defining the respective point—The fields are activated only after activating the check box.
  (2) Deactivating defined values.

- *Ref* and *X*; *Y* and *Z* text boxes:
  The specifications in this boxes are made in the same way as in the boxes with the same names for the driver SRP—see above *Reference point* and *X; Y; Z* text boxes ③.

Since version 1.12.2 these points can also be defined via `CkeParameter`. (Use the context menu – right mouse click on the coordinate field)

⑦ Default Back Angle

Inclination angle of the backrest. Here, a value is displayed defined in the `BaseData.xml` configuration file.

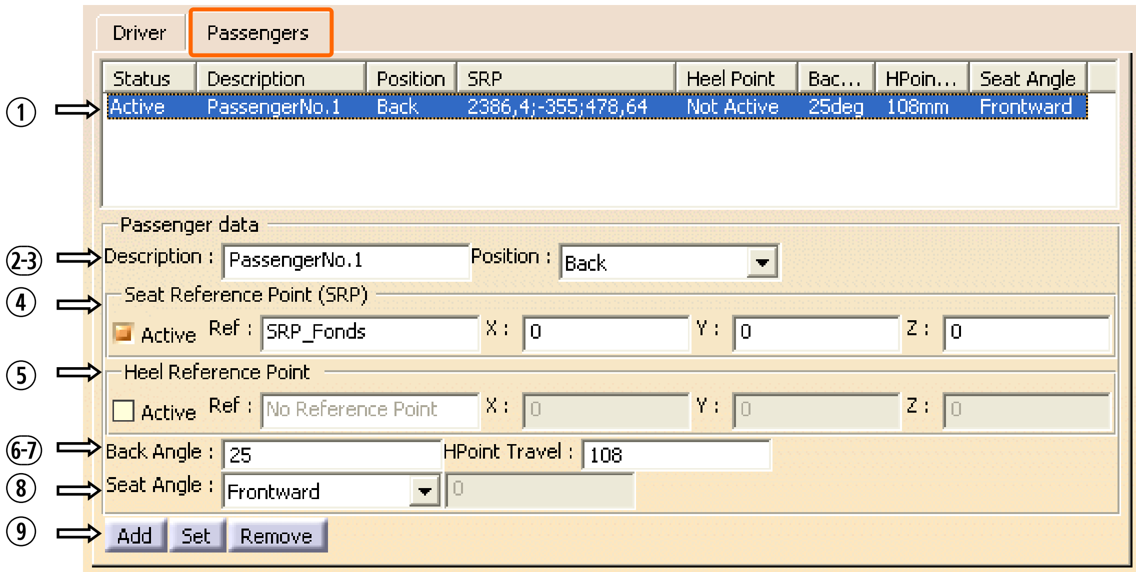
⑧ Fixed

If the seat angle is not adjustable, you have to enable the ‘Fixed’ option. This is important for the position of the eye point for the CAVA rear view mirror check, e. g. according to EG EWE 2003 where the eye points are shifted in x and/or z-direction.

⑨ HPoint Travel

The horizontal seat adjustment area is the zone of the normal driving positions, intended by the producer for adjusting the driver seat in the direction of the *x* axis.

- ***Passengers*** **sub-tab card**



① Passenger Seat List

This list contains all defined passenger seats. Use the seat definition fields ②-⑧ and the list control buttons ⑨ to manage the list elements.

② *Description* text box

While creating a seat, CAVA sets a default name for the seat in the *Description* text box. The name can be modified, giving a name that designates, for instance, the seat function (front passenger's seat, right backseat etc.).

③ *Position* list box

Under *Position* the position of the seat in the car is defined. This information is required for the calculation of the belt fields.

- Front — The seat is in front. In case of cars without front seat bench it is the front passenger's seat.
- Back — The seat is behind the front seats.

④ R*eference point* and *X; Y; Z* text boxes

Define here the seat reference point (SRP).

- *Active* check box:
  Only active points will be available for selection in the different CAVA features.

The seat points can be defined in the following ways:

- Manual definition of a CAVA seat reference point
  To do so, enter in the *x*, *y* and *z* value boxes the required values (absolute coordinates of the respective V5 point).

or

- Adoption of a reference point from CATIA
  To do so, mark the appropriate row in the list, move the mouse pointer to the text box of the respective CAVA reference point to activate the box; then click on the respective reference point in the CATIA specification tree or on the workspace—after that the reference point will be adopted in the activated text box, and press the *Set* button to commit the new reference point to the list.
  It is possible also in this case to enter additional values in the *x*, *y* and *z* value boxes. – These values will be interpreted as relative coordinates of the respective CAVA reference point, i. e. relative to the CATIA reference point—the CAVA reference point will be moved in relation to the initial CATIA reference point.

Cancelling the reference on a CATIA reference point

- Mark the appropriate row in the list.
- Activate the *Ref* text box with the mouse pointer.
- Click again on the respective reference point in the CATIA specification tree or in the CATIA workspace. After that in the text box the text "no reference point" will appear.
- Press the *Set* button to commit the new reference point to the list.

The *Active* check box for the seat reference point must be activated to be able to define seats for additional passengers. By activation of this check box also the *description* text box and other boxes, required for seat definition, are activated.

When deactivating an existing seat, it will not be removed, but will no more taken in consideration when creating new features.
If an existing seat already is referenced by other features, it can not be deactivated. In this case a warning message will be displayed.

⑤ Heel Reference Point

Activated Heel Reference Points are visualized in the model and can be referenced by other CAVA functions (e. g. by 2D MANIKIN TEMPLATE).

- *Active* check box:
  Only active points will be available for selection in the different CAVA features.

The seat points can be defined in the following ways:

- *Ref* and *X, Y* and *Z* text boxes:
  The specifications in this boxes are made in the same way as in the boxes with the same names for the driver SRP—see above ④

⑥ Default Back Angle

Inclination angle of the backrest. Here a value is displayed defined in the `BaseData.xml` configuration file.

⑦ HPoint Travel

The horizontal seat adjustment area is the zone of the normal driving positions, intended by the producer for adjusting the driver seat in the direction of the *x* axis.

⑧ *Seat angle* list box and *Angle* spinner

Here the seat position can be defined. With the list box, it can be adjusted in 90 deg steps; if in the list box the *custom* option has been selected, in the spinner box on the right a free angle definition is possible.

Seat Angle

• Frontwards	(0 deg)	Seat position driving direction
• Backward	(180 deg)	Seat position opposite to the driving direction
• Left	(-90 deg)	Seat directed towards the left side of the car.
• Rigth	(90 deg)	Seat directed towards the right side of the car.
• Custom		Specify in the spinner box on the right a value for the seat position (in deg).
	1 to 179°	Turning the seat rightwards.
	−1 to −179°	Turning the seat leftwards.

⑨ List control buttons

- Adding new elements to the list:
  You can add additional elements to the list using the *Add* button. All values that are defined in the fields ②-⑧ will be committed to the list.

If the seat name already exists in the list you will get an error message. Change the name of the seat and retry again.

- Changing values in the list:
  Mark the list element you want to change with the mouse pointer. The values of the selected list element are put to the fields ②-⑧ .Now you can change the values in the respective fields. Commit the values back to the list by using the *Set* button.

- Removing elements from the list:
  Select the list element you want to remove and click the *Remove* button.

☞ The settings in the boxes "Description" / "position" and "Seat angle" do affect the *Seat belts*, *Child Protection* and *Free Space* features.

2.5 Loadings

The term „loading“, which is used on the CAVA GUI is synonymous with the more precise term “loading plane”. The *Loadings* tab comprises two sub-tab cards—“Preconfigured Loadings” and “User-defined Loadings”.

On the *Preconfigured Loadings* sub-tab card, the CAVA-predefined loading plane and the administrator-defined loading planes are listed.

On the *User-defined Loadings* sub-tab card the user can define his own loading planes (see section 2.5.2 *User-defined Loadings* on page 24.)

2.5.1 Preconfigured Loadings

The preconfigured loadings are defined in the `BaseData.xml` configuration file. Renaming existing loadings, changing their values or adding new loadings is possible only by editing the `BaseData.xml` file—this right is reserved exclusively for the administrator.

The loading named ”Vehicle grid parallel” is the CAVA default loading plane.

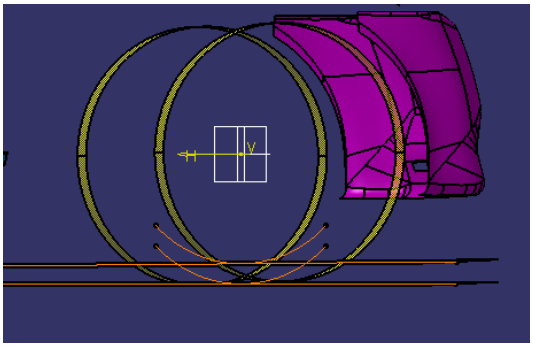
The position is determined by the *z* coordinate of the front and rear wheel including the R_{stat} and wheel camber etc. The road plane is created parallel to the *XY* plane with the mean value of the *z* coordinates of the front and back wheel.

Irrespective of the values specified for the wheels, the orientation of this loading plane is in every case parallel to the vehicle grid. It can not be modified either by the administrator or by the user, and—as it must be always available—can not be removed.

The *Vehicle-grid parallel* loading plane in CATIA workspace is visualized, using the wheel data, defined on the *Wheels* tab card (see section 2.3 *Wheels* on page 9). To visualize the wheels, the nominal diameter specified there is used.

Also in the midplane of the car the static diameter is visualized as circular arc.

For all other, additional loading planes, solely the static radius is visualized in the car midplane.



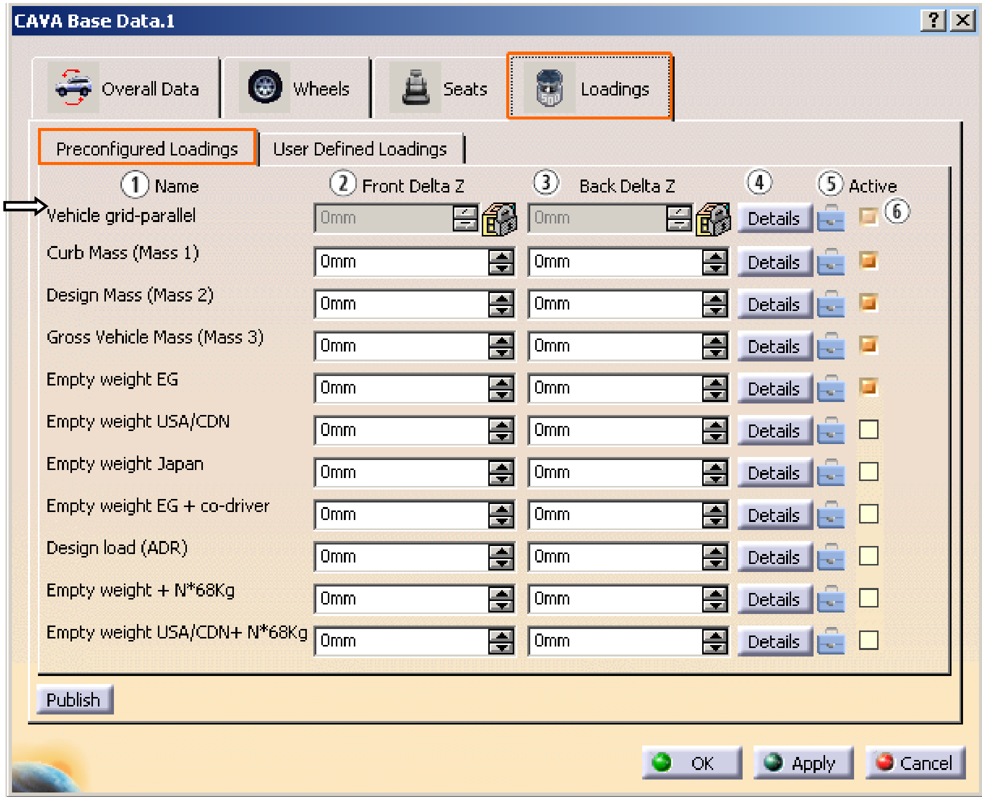
Visualization of the CAVA loading planes in CATIA workspace

The fig. shows:

—the grid-parallel loading plane (which has been created first, and which is represented by the lower one of the two red lines) with two wheels with nominal diameter and a circular arc, which adumbrates the static diameter.

—the additional loading plane (the upper red line) with an additional circular arc.

(1-6)



① Name

The names of the loadings are predefined in the configuration file.

Since version 1.12.1 it is possible to define the coordinates of the road level as absolute coordinates, i. e. with reference to the origin coordinate system. To do so, select the ‘Loading data definition’ option in the *Details* dialog of the respective loading plane (see ④).

② *Front Delta* spinner box

When the option ‘Loading data definition’ is set to ‘Relative’, this value defines the translational displacement of the front-wheel center points in the *z* direction that is caused by a loading.

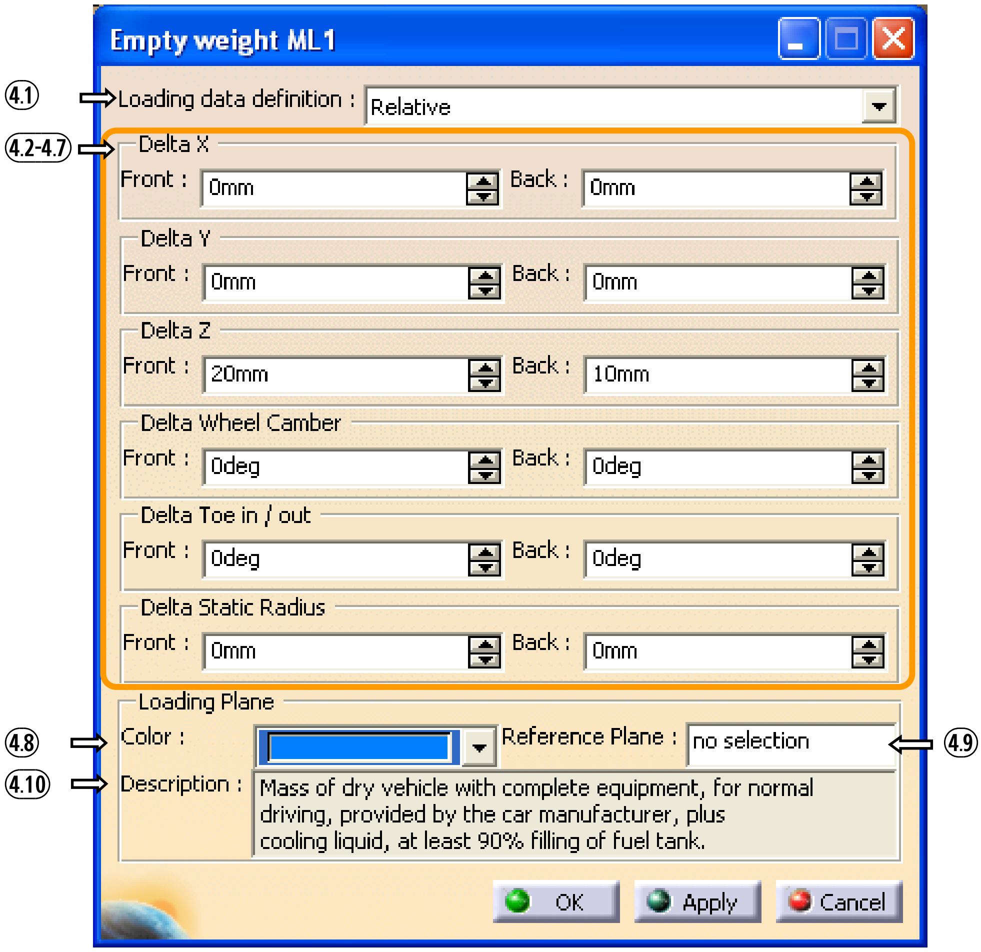
When the option ‘Loading data definition’ is set to ‘Absolute’ this value defines the position of road plane for the front wheel (center point) in the *z* direction, caused by a loading.

③ *Back Delta* spinner box

According to ②.

④ *Details* button

When this button is pressed, the following dialog box is opened (which is uniform for all loading planes):



④.1 Loading Data Definition

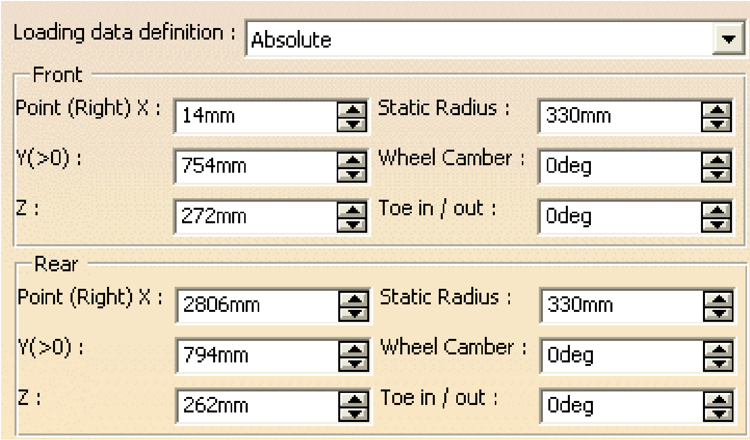
- Relative: The position of the loading plane is defined relative to the wheel center points.
- Absolute: The position of the loading plane is defined by absolute coordinates related to the origin coordinate system.
  When using this option, the user dialog changes as described below.

④.2-④.7 Delta Values

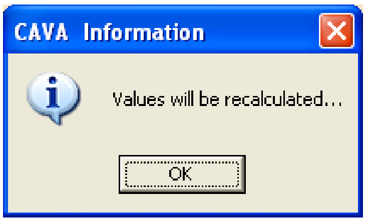
Here you can define delta values in addition to the delta values specified in the *Preconfigured Loadings* dialog window.

☞ The *delta z front* and *back* values are identical with those from the *Preconfigured Loadings* dialog window (see above ② and ③).

Dialog box for ‘absolute’ loading data definition



When changing the loading plane data definition from *Relative* to *Absolute* (or vice versa), the values are recalculated according to the wheel center definition on the *Wheels* tab card. An alert will indicate this:



4.8-4.9 Loading Plane

Here certain properties can be attributed to the loading planes:

4.8 *Color* list box

Here you can select a color to be assigned to the loading plane. The visualization is updated immediately after selection.

4.9 *Reference Plane* reference box

Here you can select a plane from the model to be used as loading plane. After selecting the plane, the position data will be filled in the respective boxes of the *Details* dialog; after clicking the *Apply* or *OK* button, the data also will be filled in the boxes of the loading planes dialog window.

4.10 *Description* text box

This text box displays a detailed description of the loading, if available. The description cannot be edited by the user; it is taken from the `TCACAVALoadings.CATNls` file, which is situated in the `\intel_a\resources\msgcatalog` or (when working with CAVA in German language environment) `\intel_a\resources\msgcatalog\german` subdirectory of your CAVA installation.

5 *Brief-case* status symbol

fications have been made in the details dialog box (i.e. additional values have been specified) or not.

If this symbol is displayed, *no* modification has been made in the *Details* dialog box.

If the symbol with the red tag is displayed, some additional delta values have been specified in the *Details* dialog box.

If the symbol with the yellow tag is displayed, absolute coordinates have been defined for the loading plane position in the 'Details' dialog. (Z-Delta definition in loading dialog is disabled.)

⑥ *Active* check box

Select this check box to activate the selected loading plane so that it can be displayed by CAVA. Only active loadings can be referenced by other CAVA functions.

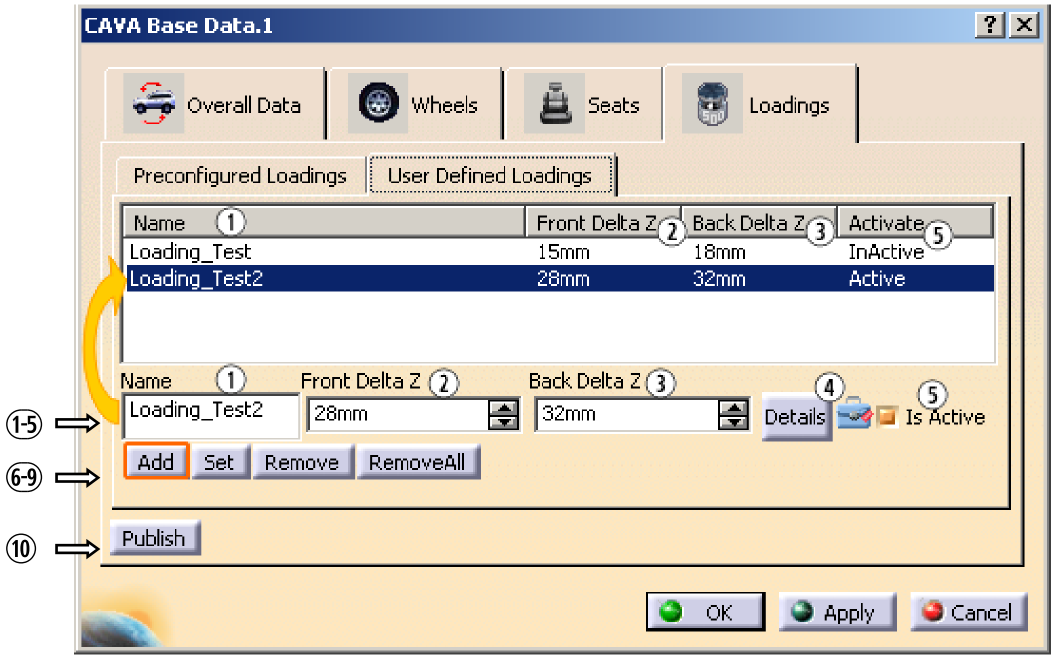
The *Vehicle grid parallel* loading can not be deactivated!

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

2.5.2 User-defined Loadings

Here individual loadings (more precisely: loading planes) can be generated. However, the use of user-defined Loadings is subject of some restrictions:

- They are valid only for the respective basis-data feature and for the models created on its base.
- They can be applied for a CAVA feature only in case that the *Free* mode is active (free selection of the loading, the standard being deactivated).



CREATING A NEW USER-DEFINED LOADING

(1) Enter in the boxes ①...③ the required data.

(2) If necessary, activate the *Active* check box ⑤.

(3) If necessary, press the *Details* button ④ and make there the detail specifications for the loading plane.

(4) After all specifications for the loading plane are done, press the *Add* button ⑥. After that, the new loading plane will be added to the list above.

① *Name* text box

Enter a concise and meaningful name for the loading.

② *Front Delta Z* spinner box

This value defines the translational displacement of the front wheel center points in the *z* direction, caused by a loading.

③ *Back Delta Z* spinner box

This value defines the translational displacement of the rear wheel center points in the *z* direction, caused by a loading.

④ *Details* button with *Brief·case* status symbol

See 2.5.1 *Preconfigured Loadings* on page 18—items ④ Details button and ⑤ *Brief·case* status symbol.

⑤ *Active* check box

Select this check box to activate the selected loading plane so that it can be displayed by CAVA. Only active loadings can be referenced by other CAVA functions.

⑥ *Add* button

Pressing this button adds the newly defined loading to the list of user-defined loadings. In case the loading is not yet activated, in the status column *InActive* is displayed. In this case, the loading can not be displayed by CAVA and can not be referenced by other CAVA functions.

⑦ *Set* button

Pressing the *Set* button transfers modifications to a loading plane. In order to do so, select the loading to be changed in the loadings list and enter the new values into the respective boxes. To apply the modified values, press the *Set* button. If the modified loading had already been used, the dependent parameters in the model are changed at the same time.

⑧ *Remove* Button

Pressing this button removes the highlighted loading from the list of user-defined loadings.

⑨ *Remove all* Button

Pressing this button removes all entries from the list of user-defined loadings.

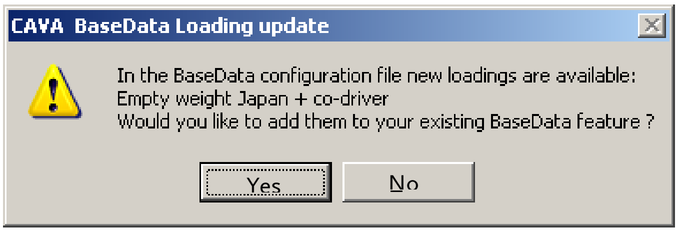
⑩ *Publish* button

If this button is pressed, all active loadings—the preconfigured and the user-defined loadings—will be published.

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

2.6 Base-Data Synchronization

If the configuration file for the base data (`BaseData.xml`) contains loadings that are not included in an existing base-data feature, a message will pop up when opening the feature and will ask you whether to update the base-data feature or not.



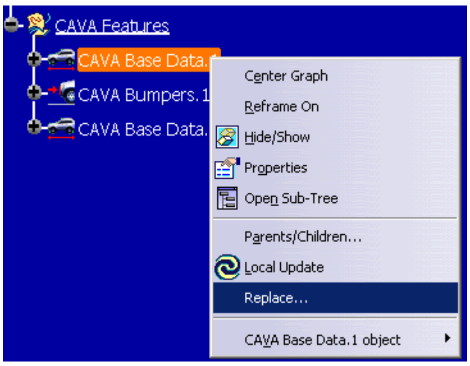
Click on „*Yes*“ to add the new loadings to the current base-data feature or on „*No*“ to leave the base-data feature as it is.

This gives you the possibility to update the loadings without the need to recreate the base-data feature.

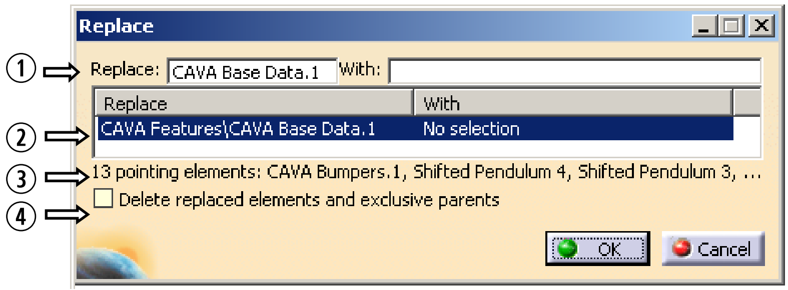
2.7 Replace the Base-Data Feature

The *Replace* functionality allows you to exchange a base-data feature by another one. All CAVA features that references the exchanged base data will be updated to the new base data and recalculated.

To call the *Replace* functionality right click on the base data feature you want to replace.



Select in the context-sensitive menu the *Replace* option. The following dialog box will open:



① Replace / with

In the *Replace* field select the base data feature you want to replace in the workspace or in the specification tree. In the *with* field you have to define the base data feature that should replace the base data selected in the *Replace* field.

② List containing the selected elements.

③ Number and names of the elements that are affected by the replacement.

④ If activated the replaced base data feature is deleted from the model.

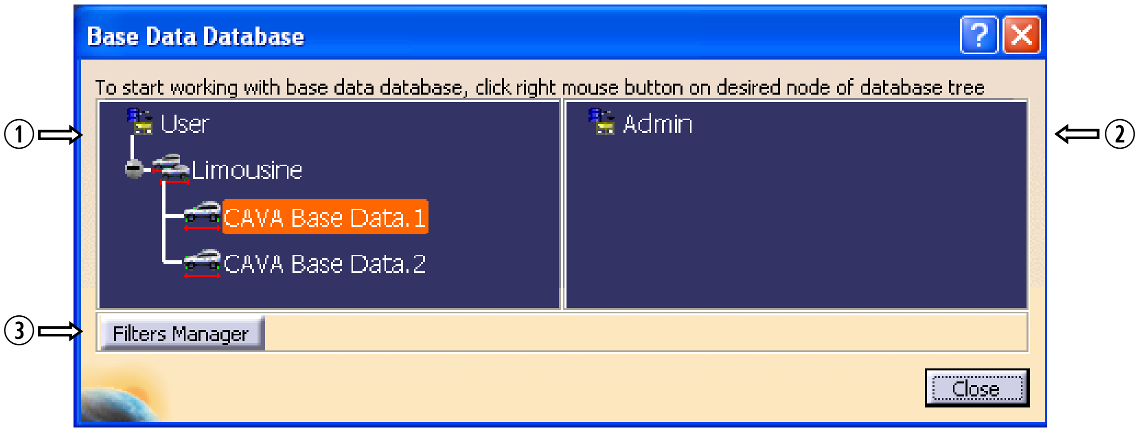
2.8 Base-data data base

In the base-data data base the existing base data is stored and managed. The content of the base data is stored in an XML file or optionally in an XLS (EXCEL workbook) file. These files are created in the directories defined under *Tools > Options > CAVA > Administration*.

If you use an Excel sheet to calculate your base data parameters, you can easily use it to create CAVA Base-Data Features. The table only has to fit to a specific layout.

- ### Opening the data-base dialog box

Click in the OVA tool bar on the CAVA base-data data base icon.
The dialog box below will be opened.



① User

Window area for user base data administration

② Administrator

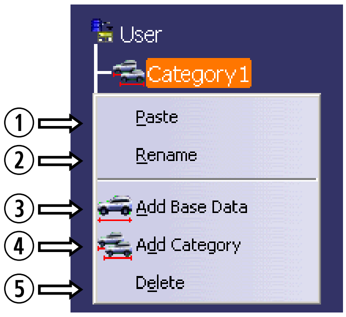
Window area for administrator base data administration.
Can be accessed only by administrators.

The data in the administration window is organized hierarchically. In both the *User* and the *Admin* area, there is a root element, the child elements of which are base-data categories or base-data datasets. Base-data categories are containers for different base data. Categories may contain further sub-categories.

The administration tree can be expanded or collapsed by clicking on the root element (like in the CATIA specification tree).

Commands for editing the administration tree are on the context menu (use right-click) of the tree elements. Depending on the selected tree element, different commands will be available on the context menu.

• Context Menu of Root Element and Category



① Paste

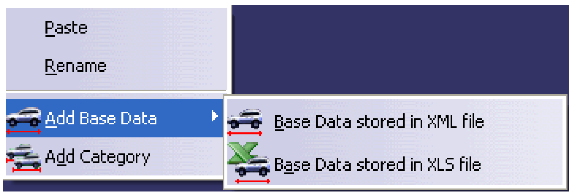
Below the selected element, an element from the clipboard is inserted.

② Rename

Renames the selected element. Select the menu item to display the *Rename* dialog.

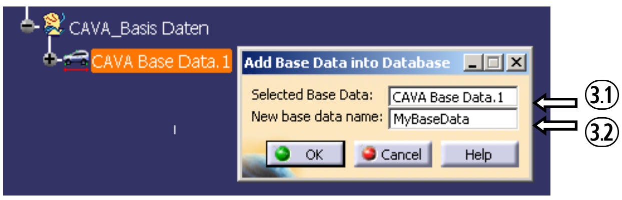
③ Add Base Data

Adds a new base-data element to the currently selected category. Place the mouse pointer on this menu item, and select from the sub-menu the desired file format (XLS or XML) for saving the newly created CAVA Base Data in the data base.



The “Add Base Data” dialog opens (see figure below).

With the dialog open, click in the CATIA specification tree on the CAVA Base Data feature that you wish to add. The name of the selected base-data feature is copied to the boxes ③.① and ③.②. In text box ③.②, the base-data feature can be renamed with an alias name, which will be shown in the administration tree of the data base.



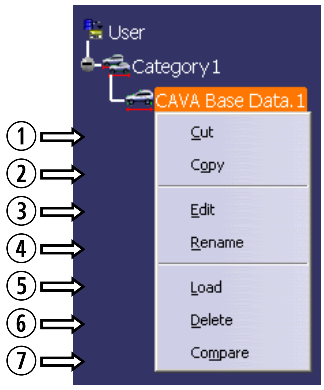
④ Add Category

On the selected position a new category will be inserted. You can set a user-defined name for the category.

⑤ Delete

Delete the selected element from the tree and from the data base. You are prompted to confirm or abort the action before the element is deleted.

- ## Context Menu of the Base-Data Dataset



① Cut

Delete the selected base-data dataset from the tree and store it on the clipboard. Use *Paste category* to add the base-data dataset from the clipboard to a category.

② Copy

Copy the selected base-data dataset to the clipboard. Use the *Paste category* option to add a copy of the base-data dataset to a category.

③ Edit

The selected base-data dataset will be opened in the CAVA base data feature dialog, where the respective values can be edited.

④ Rename

Rename the selected base-data dataset.

⑤ Load

Adds the selected base-data dataset as CAVA base-data feature to the active geometrical set of the active model. If no geometrical set is active, the base-data feature will be added to the next possible geometrical set. If in the active CATPart no geometrical set is active, a new geometrical set will be created.

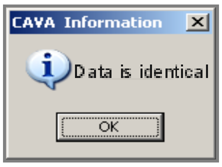
⑥ Delete

Delete the selected element from the tree and from the data base. You are prompted to confirm or abort the action before the element is deleted.

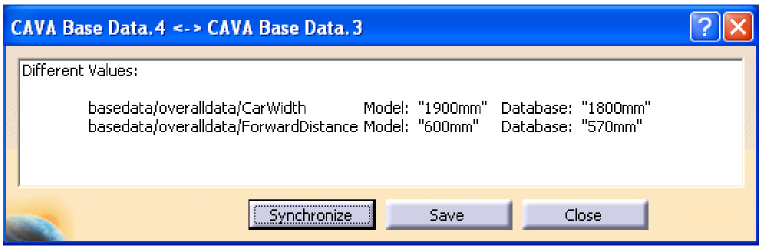
⑦ Compare

The content of the base-data dataset selected in the administration tree will be compared with a base-data feature, which is to be selected in the dialog by clicking on a base-data feature in the CATIA specification tree.

If the compared base-data is identical, the following message will be displayed:



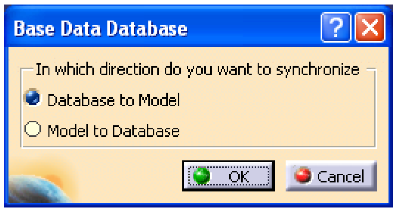
If in the compared base data different values have been found, the differences will be listed in a dialog.



Synchronize

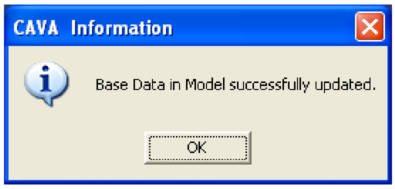
This option enables the user to synchronize database data with model base data or vice versa.

Click the *Synchronize* button. This opens a dialog box where the synchronization direction can be selected.



Confirm your selection by clicking the *OK* button.

When the synchronization is accomplished, a message will be edited.

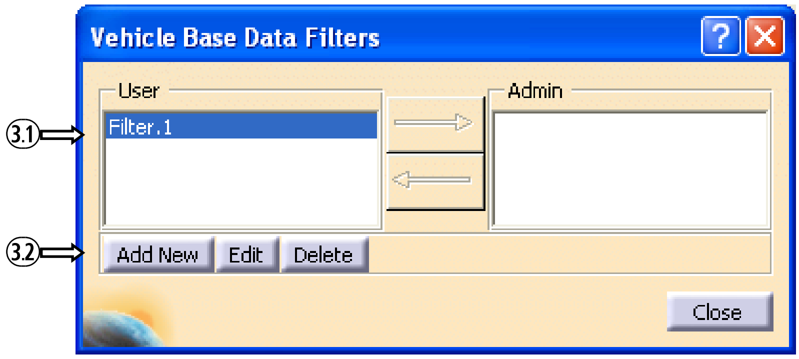


③ Filter Manager

You can use the 'Filter Manager' to create rules for the export of CAVA base data features as XML or XLS file. You can exclude specific parameters from export or save parameters as faked values.

Use this command if you want to export a set of base data, where the recipient does not need all data or should not know about all the detailed data.

The created filters are stored as XML files in a separate directory named„Filter“. This directory resides in a subdirectory of the directory that is defined in the Tools/Options ... settings for the base data database (User and Admin).



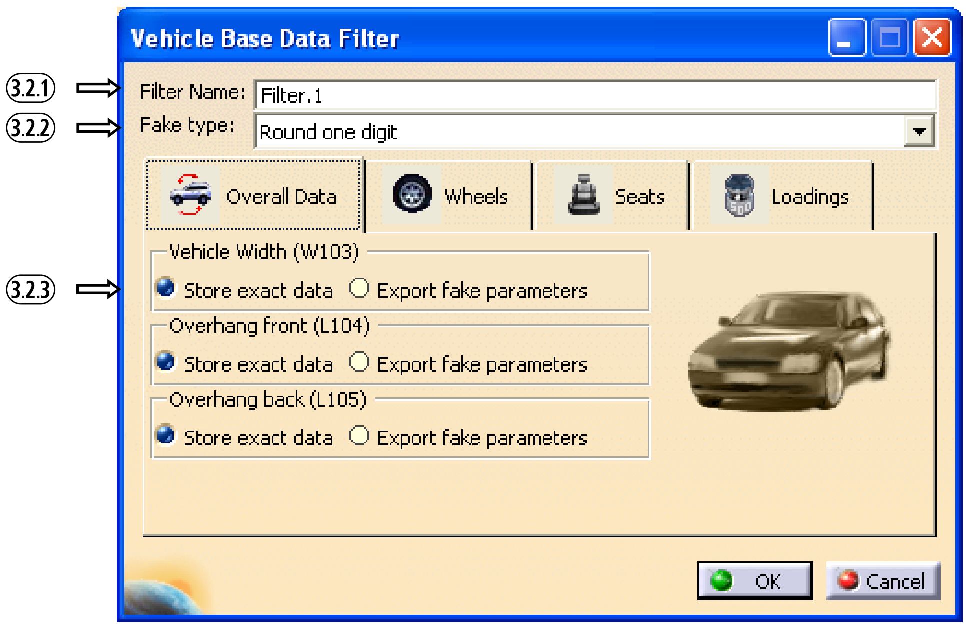
3.1 Filter lists

List-administration for *User* and *Admin*. Use the arrow buttons ( ) to move the filter definition files from the admin to the user section or vice versa. (Administration rights are required.)

3.2 List controls

- Add New:

Click this button to define a new export filter. A dialog opens as shown below.



3.2.1 „Filter Name“ text box

Define here the name of the filter. To ease your work, you should use a meaningful, unambigious name that describes the purpose of the filter, so you can identify it later on in your list of different filters.

3.2.2 “Fake Type” list box

For reasons of data security you can fake the original base data values during export, so that the recipient does not get the exact values. This fake is done by rounding the values. Currently, the following fake methods are available:

- *Round one digit*
  This method rounds the last decimal digit of the original value.
  Example: 110,57 turns to 111
- *Round two digits*
  This method rounds the last but one decimal digit of the original value.
  Example: 110,57 turns to 110,0

In the respective tab cards you can define for each base data parameter whether it should be exported or not and if yes, what export method (original/fake) should be used.

3.2.3 “Overall Data“ tab card

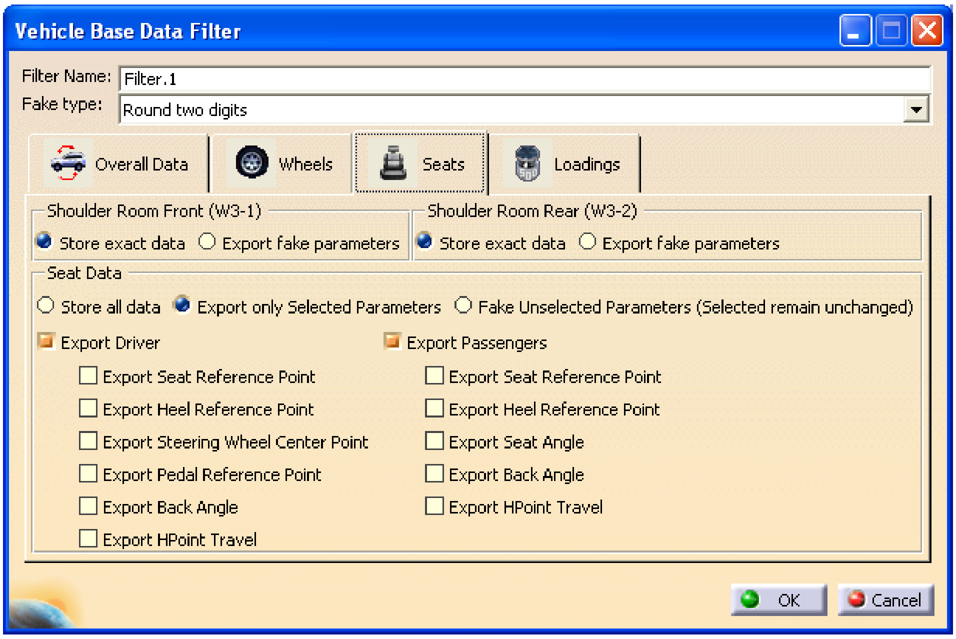
- Store exact Data or
- Export fake parameters

3.2.4 ⇨

3.2.4 Tab card „Wheels“

- Store exact Data or
- Export fake parameters
  If you have enabled this option and have selected to export the loading data as exact data (in tab card *Loadings)*, all loadings that are related to the wheel position are exported by their original values but with respect to the faked wheel data.

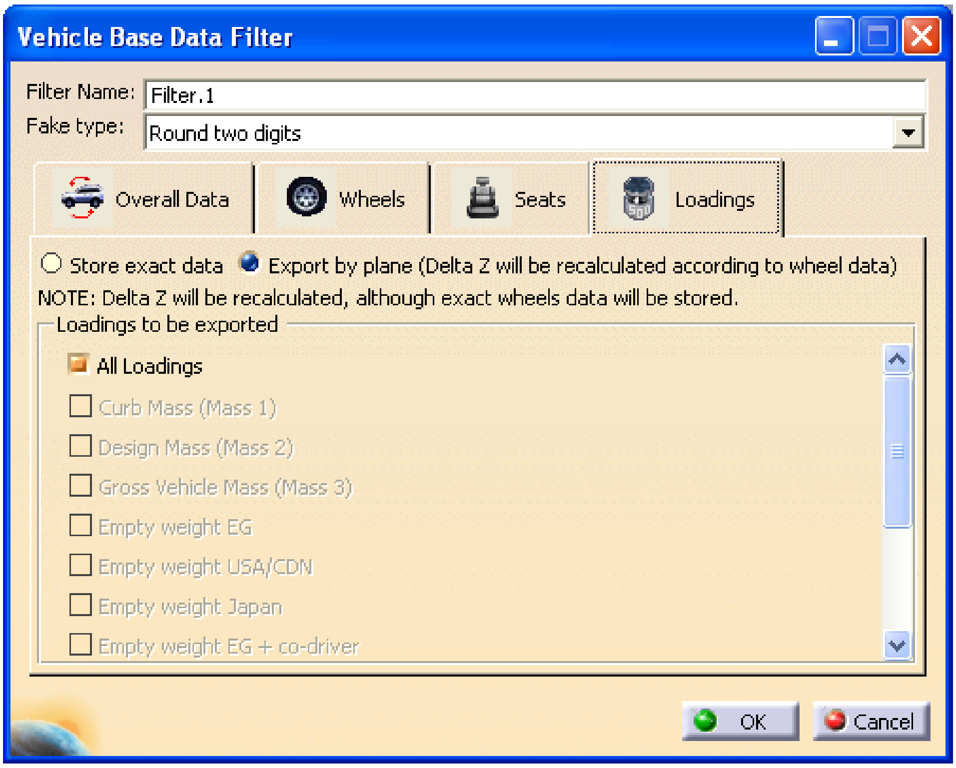
3.2.5 ⇨



3.2.5 Tab card „Seats“

- Store all Data or
- Export fake parameters or
- Fake Unselected Parameters

3.2.6 ⟹



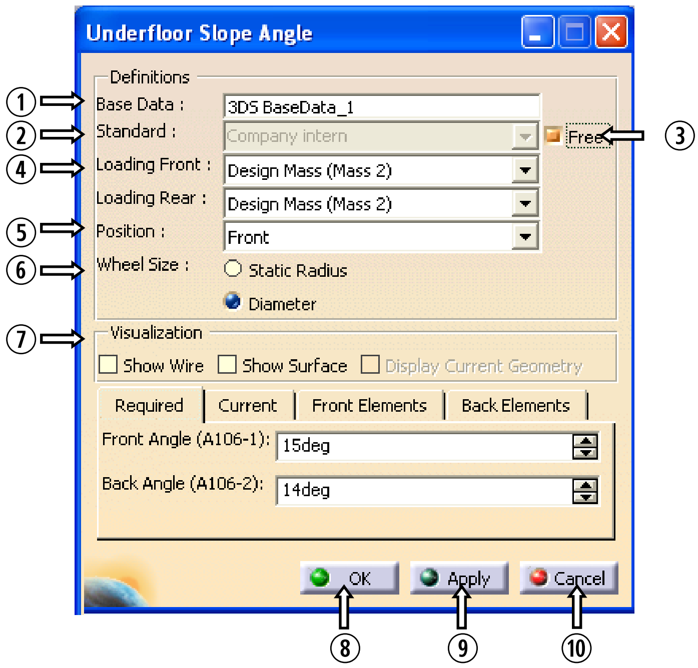
3.2.6 "Loadings" tab card

- Store exact Data or
- Export by plane

If you have enabled this option and have selected to export the wheel data as exact data (on the *Wheels* tab card), all loading planes that are related to the wheel position are recalculated.

3. General Input Data for the OVA Functionality

- Below the input boxes will be explained that you can find repeatedly in the most of the dialog boxes. The *Underfloor Slope angle* dialog box here is used only as an example.
- An explanation will be given for all general input boxes regardless of whether they are activated or deactivated in the currently selected mode (standard or free mode).



Definitions

① *Base Data* reference box

Reference here from the model the relevant base data. This activates the required data for the respective vehicle category. See chapter *Base Data* on page 6.

② *Standard* list box

Select a standard. The standards contain the predefined values that are required to create the respective feature according to the security rules. The individual standards and their values, available in this field, are stored in the respective configuration file (e.g. in `UFSlopeAngle.xml` for the Slope Angle Feature)

③ *Free* check box

Activating this check box results in activating the *Free* mode, whereas the *Standard* list box will be deactivated.
(For detailed explications see CAVA User Manual—General, section Creating CAVA features—General Proceeding.)

This button will be active as soon as base data have been selected.

By pressing the *Free* button you can avoid the defaults and define your own settings for specific values.

④ *Loading* list box:

- If deactivated — *(i. e. only in Free mode)* The list box contains all loadings that are activated in the base-data dialog box on the *Preconfigured Loadings* and *User-Defined Loadings* tab cards.
- If activated — The default value is defined by the standard in the configuration file.

⑤ Position

- *Front* — The operation is executed only for the front part.
- *Back* — The operation is executed only for the back part.
- *Both* — The operation is executed for both the front and the back part.

⑥ *Wheel Size* radio button

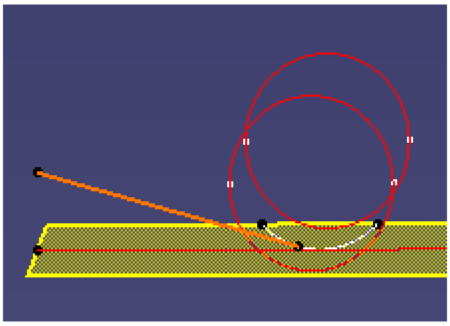
(These option is not found in all dialog boxes.)
Some of the underfloor standards use the static wheel radius, other standards—the nominal diameter. In order to take account of this fact, in the respective configuration file is defined which value is used.

- If deactivated: A default value is used that is defined in the configuration file.
- If activated:
  - Static Radius — For calculation the static radius defined in the base data is used.
  - Nominal diameter — For calculation the nominal diameter defined in the base data is used.

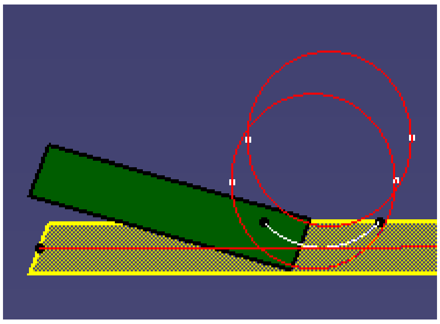
⑦ Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Wire* option:
  The features are visualized as wire model.



- *Surface* option
  The features are visualized as surface model.

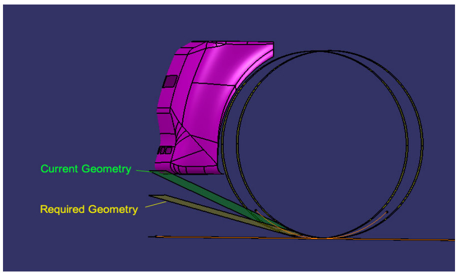


It is also possible to activate both visualization modes.

For the visualization of the individual CAVA features see the sections on the respective CAVA function.

Display current geometry option

If the *Display current geometry* option is activated and if the list on the Elements tab card(s) contains a geometry feature, then—additionally to the required geometry—the current geometry will be displayed.



⑧ *Required, Current* and *Elements* tab cards

The concrete content of the tab card is described in the sections on the individual CAVA functions. For the general proceeding how to use these tab cards see CAVA User Manual—General, section CAVA Measurements.

- *Required* tab card

The *Required* tab card contains the settings to be observed which the current values are compared with for the measurements.

- *Current* tab card

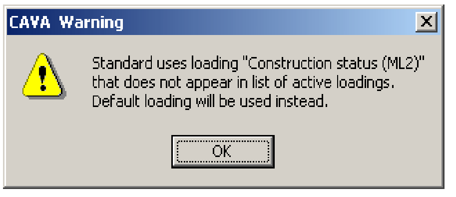
On the *Current* tab card the measurement results are displayed. For detailed description see CAVA User Manual—General, section CAVA Measurements.

- *Elements* tab cards

On the tab card(s) (in our example *Front Elements* or *Back Elements*), elements can be listed (referenced) that are to be used for the measurement with the respective CAVA function (For detailed proceeding see CAVA User Manual—General, section "CAVA Measurements"). If several tab cards are available, they differ in the features referenced or in the position of the features on the vehicle, but the proceeding how to select the features for the elements list is uniform.

3.1 Loadings

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



4. Underfloor Features

A number of functions are offered, which primarily represent required and current values regarding the underfloor.
The Underfloor Features group comprises the following individual functions:

- Slope Angle
- Static Curb
- Dynamic Curb
- Ground Clearance
- Inner Angle
- Oil Pan
- Wheel Fixing
- Underfloor Complete.

Detailed description of these functions will be given in the following sections of this manual.

4.1 Slope Angle

This function allows the user to check the observation of the rules for the front and back slope angle. The slope angle is the angle between the loading plane and a tangent plane at the circumference of the tire (defined by the nominal diameter or the static radius) seen in the lateral view.

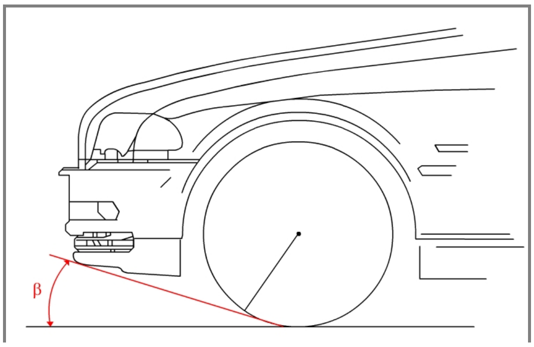
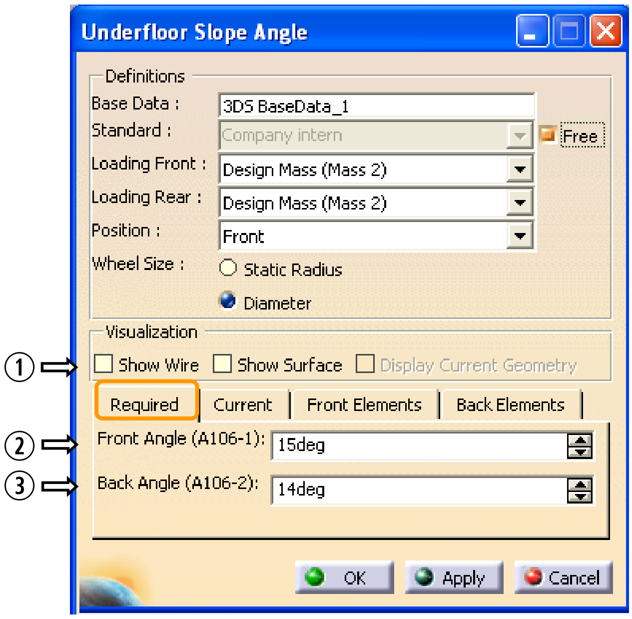


Fig.: Slope angle ß

• Specifications on the GUI

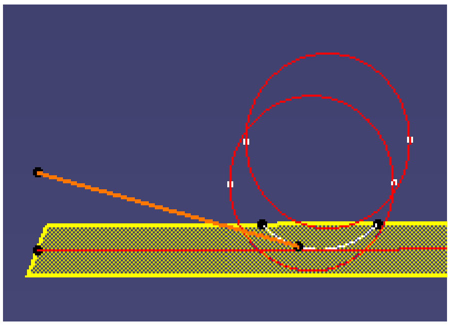
For this CAVA function you can select a separate loading plane for the front and the rear.

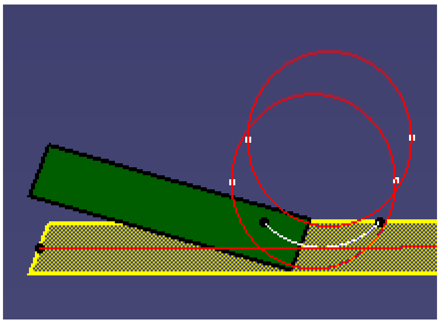


① Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Wire* option*:*
  The features are visualized as wire model.
- *Surface* option
  The features are visualized as surface model.





It is also possible to activate both visualization modes.

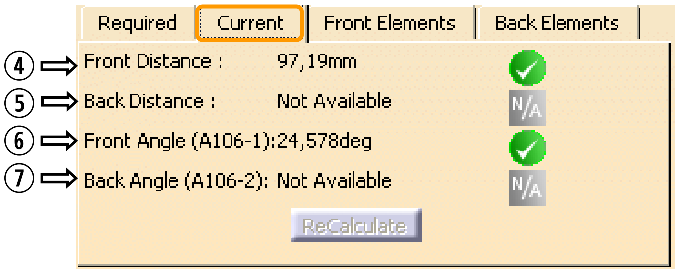
- *Show current geometry* option

See page 38.

Required tab card

② ③ *Front Angle/Back Angle* spinner boxes

Front/back slope angle.



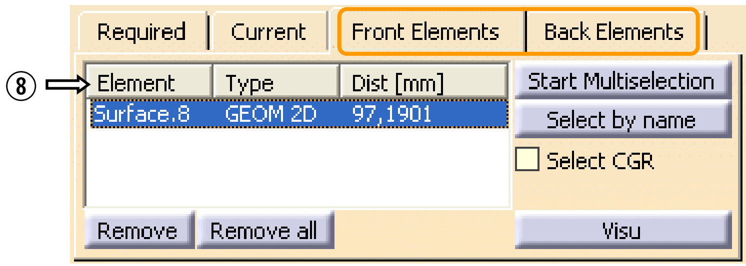
Current tab card

④ ⑤ Measurement result output for Front Distance/ Back Distance

Distance from front/back slope angle to the selected feature. The distance is measured vertically to the loading plane, and, thus, may slightly deviate from the measurement results of the CATIA measurement tool.

⑥ ⑦ Measurement result output for Front Angle/Back Angle

Measured value of the front/back slope angle.



Front Elements/Back Elements tab cards

On the *Front Elements* and *Back Elements* tab cards the features can be selected, which are to be used for checking the front/back slope angle; the tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

⑧ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the front/ back slope angle. These features will be included in the list of the respective tab card.

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

4.2 Static Curb

The static curb function checks the clearance between the car geometry and the road surface for the area in front of the front wheel, or for the area behind the rear wheel. The static curb clearance line runs with the angle β from the point of intersection of the line a (vertical distance from the road surface) with the static radius r_{stat} in forward direction (in case of the front static curb) or in backward direction (in case of the back static curb)

If it is intended to consider only the vertical distance to the road, an angle of 0 deg must be specified.

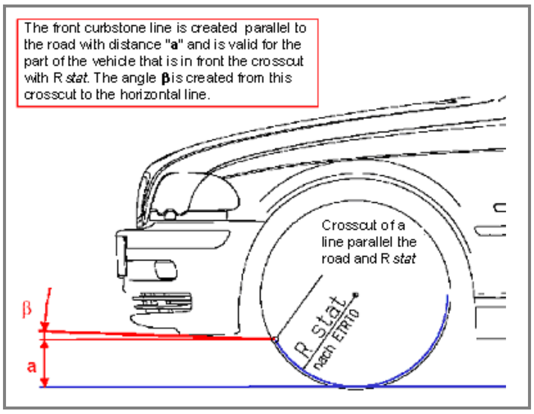
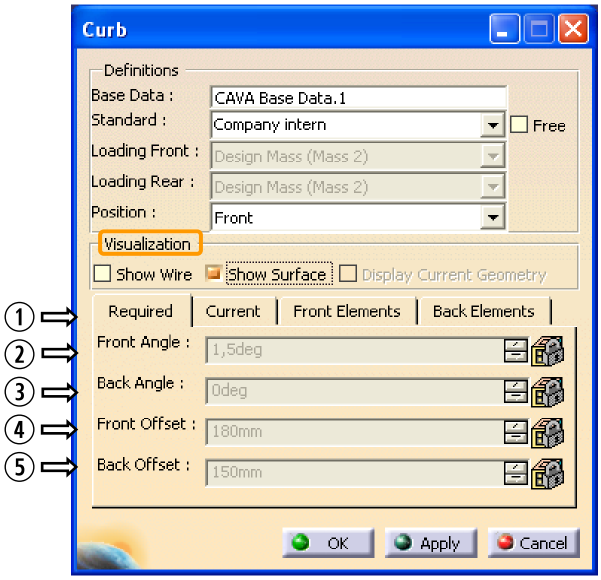


Fig.: Static curb (front static curb)

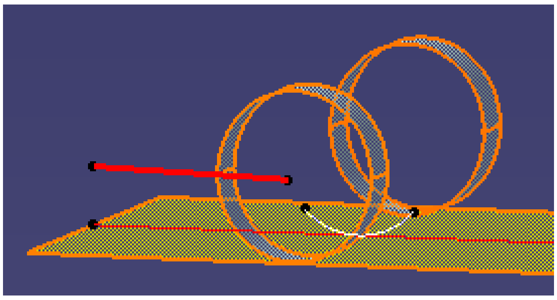
- ### Specifications on the GUI

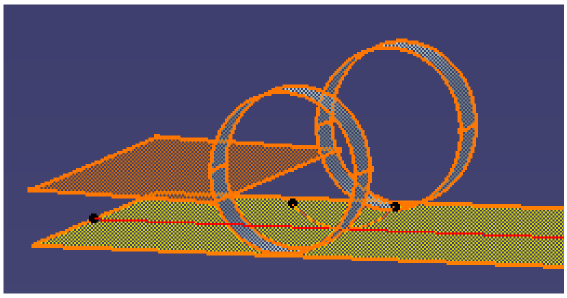
For this CAVA function you can select a separate loading plane for the front and the rear.



① Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:





- *Surface* option
  The features are visualized as surface model.

- *Wire* option*:*
  The features are visualized as wire model.

It is also possible to activate both visualization modes.

- *Display current geometry* option

See page 38.

Required tab card

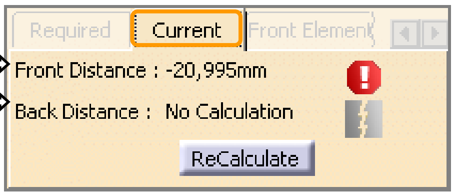
② ③ *Front Angle/Back Angle* spinner boxes

Angle β, which is applied to the point of intersection between the front/back curb clearance line and the static radius r_{stat}.

④ ⑤ *Front Offset* and *Back Offset* spinner boxes

Distance *a* of the front/back static curb clearance line to the road.

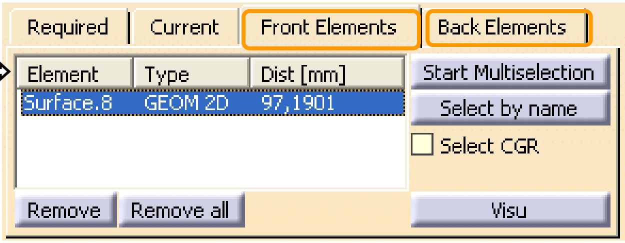
⑥ ⇨
⑦ ⇨



Current tab card

⑥ ⑦ Measurement result output for Front Distance/ Back Distance

Distance from the front/back static curb clearance line to the selected feature. The distance is calculated vertically to the used loading plane.

⑧ ⇨


Front Elements/Back Elements tab cards

On these tab cards, the features can be selected that are to be used to check the front/ back static curb clearance; (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

⑧ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the front or back static curb clearance. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

4.3 Dynamic Curb

The dynamic curb function checks the clearance under the car that enables the car to cross over a curb. For the calculation of the lines between the axes (or the resulting surfaces) CAVA provides three calculation methodes:

- horizontal:
  The boundary outline for the dynamic curb is defined by 4 lines/planar surfaces. The four lines/planar surfaces are calculated/positioned as follows:
  At a distance *a* from the road surface, parallel to this latter, in front of the front wheel, and behind the rear wheel; running respectively frontward or backward from the intersection points with R_{stat} over the length of the overhang (defined in the base data).
  Additionally, in the area between the axes (behind the front wheel and in front of the rear wheel) two lines/planar surfaces are created, which are also parallel to the road surface with distance *b* and which start at the inner intersection points with R_{stat}.

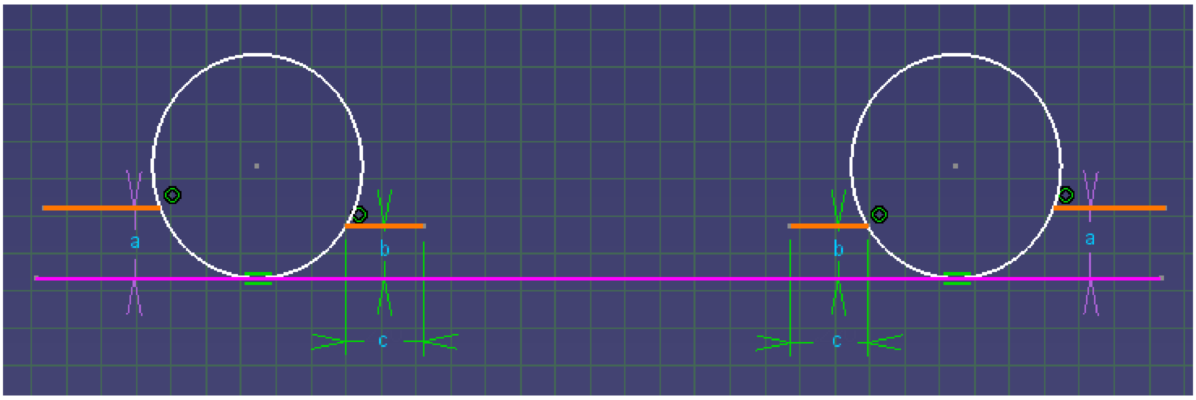


Fig.: Dynamic curb clearance—horizontal type

- tangential:
  The line/surface is not parallel to the road surface, but is situated tangentially to the other wheel, i. e. the line/surface for the front wheel starts from the point of intersection with R_{stat} of the front wheel (situated in a specified height) and touches tangentially R_{stat} the back wheel. (This applies analogously also to the back axe.) —See fig. below.

- tangential-parallel:
  The calculation is similar the tangential method; the distance in this case is not the vertical distance to the road surface, but it is specified relative to a parallel to the tangent, touching the other wheel. —See fig. below.

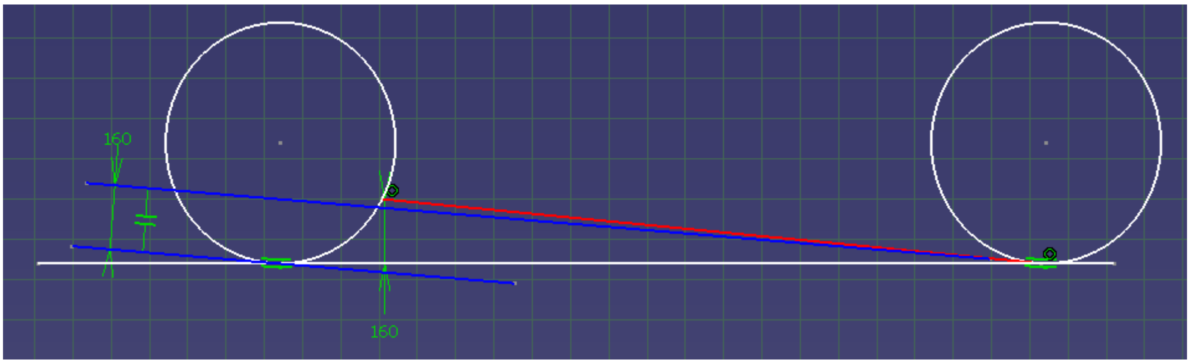


Fig.: Dynamic curb clearance—comparison of the tangential (red line) and the tangential-parallel method of calculation (blue lines)—CAVA representation with projection on one loading plane

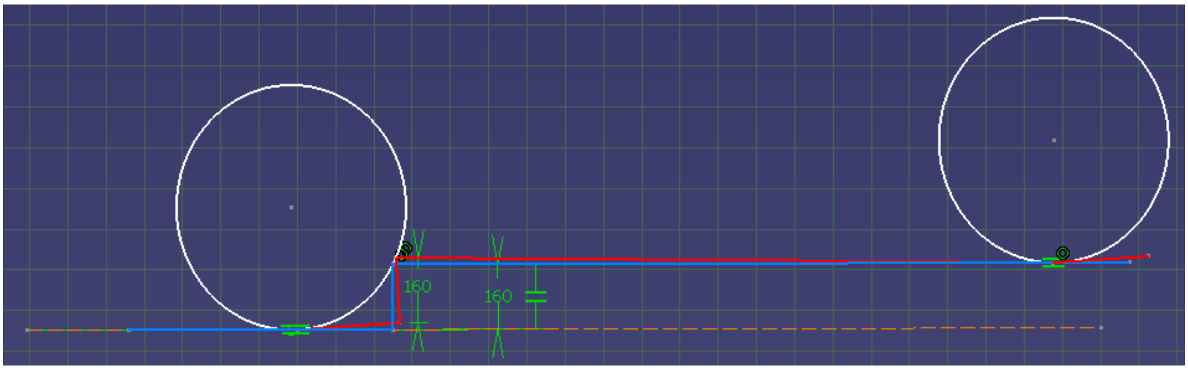
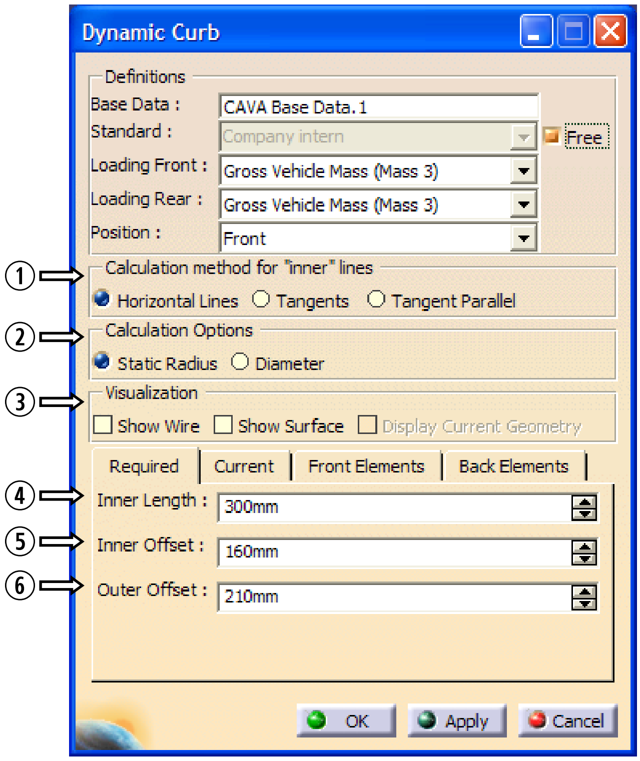


Fig.: Dynamic curb clearance—comparison of the tangential (red line) and the tangential-parallel method of calculation (blue line)—real representation of curb crossing

- ## Specifications in the GUI

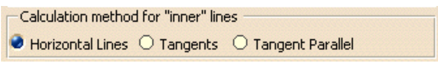
For this CAVA function you can select a separate loading plane for the front and the rear.

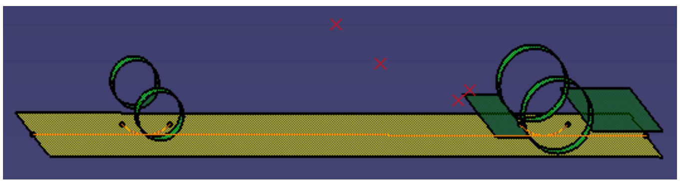


① Calculations method for inner lines

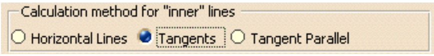
Method to calculate the inner curb line (i. e. the line, situated in the area between front and back axe). The values can be changed by the user only if the *Free* option is activated.
The calculation methods are applied as well when using the static radius as when using the nominal diameter.

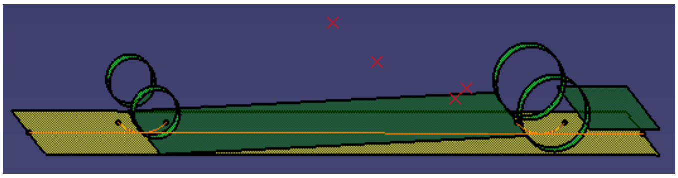
②



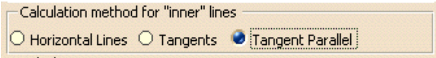


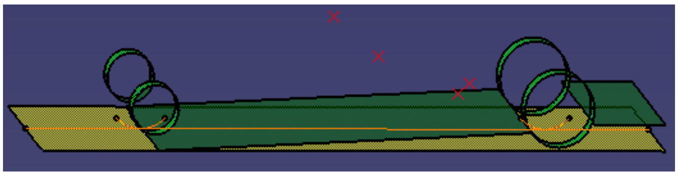
The inner curb clearance line is situated parallely to the selected loading plane. The starting point is the point of intersection of the respective wheel with the height plane. The height is defined on the *Required* tab card with the *Inner Offset* spinner box.





The inner curb clearance line starts a tangent at the point of intersection of the wheel circumference with the loading plane and runs to the point of intersection with the height plane on the opposite wheel. (The height is defined on the *Required* tab card with the *Inner Offset* spinner box.)



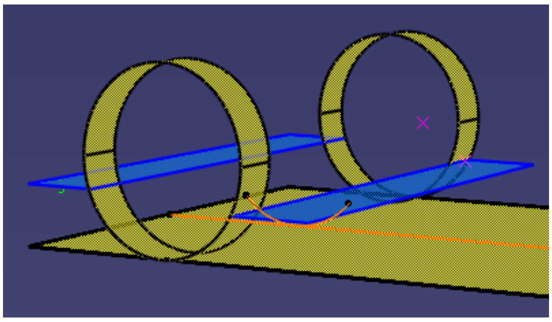


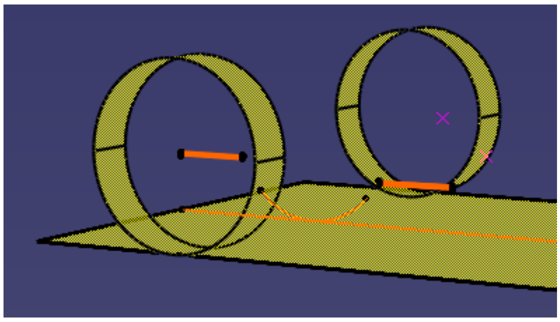
The inner curb clearance line starts as a tangent at the point of intersection of the wheel circumference with the loading plane and runs to the point of intersection with the circumference of the opposite wheel. The situation of this second intersection point is determined by the distance *b* to a parallel tangent, running through the point of intersection of the circumference of the opposite wheel with the loading plane.

③ Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Surface* option
  The features are visualized as surface model.
- *Wire* option:
  The features are visualized as wire model.





It is also possible to activate both visualization modes.

- *Display current geometry* option — See page 38.

Required tab card

The *Required* tab card contains the settings to be observed for the dynamic curb clearance. The values can be changed by the user only if the *Free* option is activated.

④ Inner length

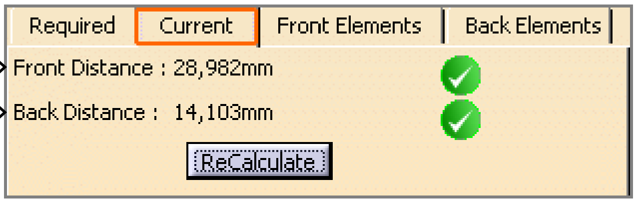
Length *c* of the inner curb clearance line The starting point is the point of intersection of the respective wheel (R_{stat}) with the height plane, the height of which is defined with the *Inner Offset* spinner box.

⑤ Inner offset

Vertical distance *b* of the inner curb clearance line to the loading plane

⑥ Outer offset

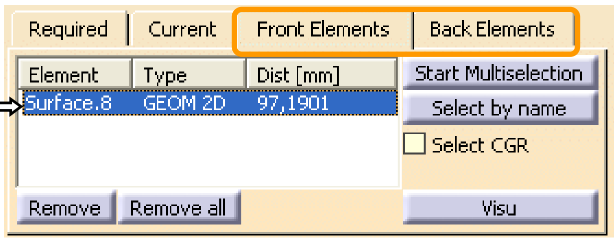
Vertical distance *a* of the outer curb clearance line to the loading plane

⑦
⑧


Current tab card

⑦ Measurement result output for Front Distance/ Back Distance
⑧

Distance from the front/back dynamic curb clearance line to the selected feature. The distance is calculated vertically to the used loading plane.

⑨


Front Elements and *Back Elements* tab cards

Select the necessary tab card for Front or Back Elements; he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.).

⑨ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the dynamic front or back curb clearance. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

4.4 Ground Clearance

Ground clearance in general is defined by a plane which is parallel to the road surface at a fixed distance. Depending on the applied standard, this plane extends over the total length of the vehicle or only over certain subareas.

Beyond this, there are standards for off road vehicles (EU, USA, AUS), which define the ground clearance beneath the axes. It can be defined by a circular arc between the wheel-road contact points (EU) and a distance to the road surface (USA, AUS, ...)—see fig.

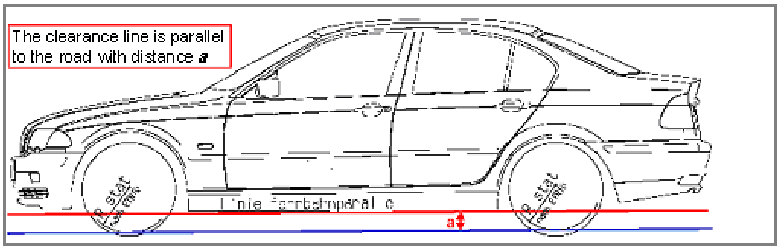


Fig.: Ground clearance in general

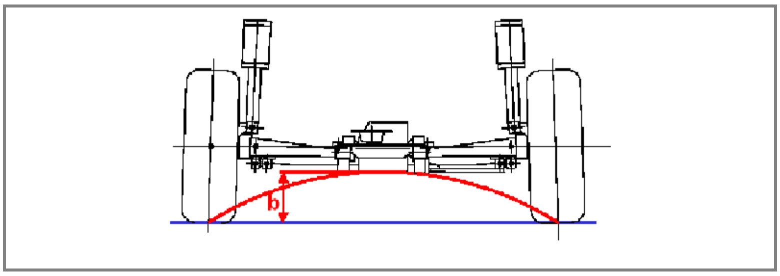


Figure: Ground clearance beneath the axes (EU default)

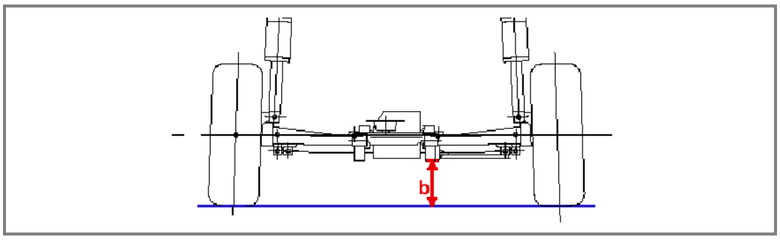
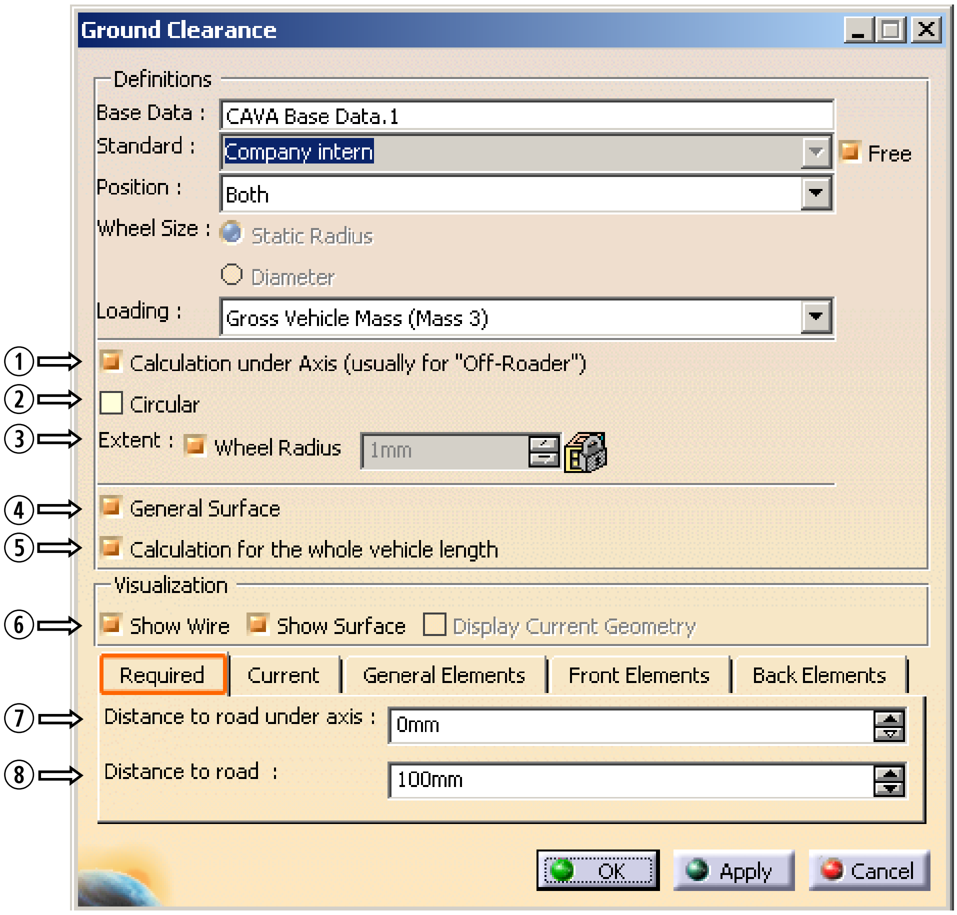
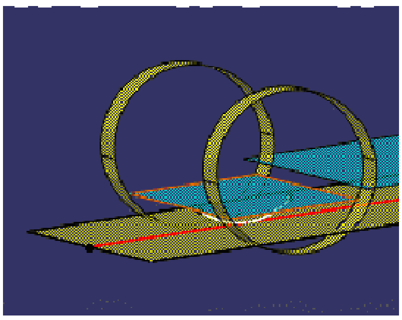


Figure: Ground clearance beneath the axes (US, Australia, ...)

- **Specifications in the GUI**



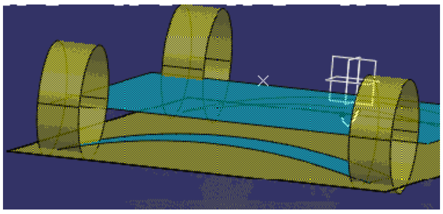
① *Calculation under axis* check box



- If deactivated:
The default is defined by the standard in the configuration file.

- If activated:
The clearance line is generated separately underneath the axes. (The dimension corresponds to the value defined with *Wheel radius* spinner box.)

② *Circular* option



- If deactivated:

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

- If activated:

The clearance line is generated as a circular arc. To do so, on the *Required* tab card in the *Distance to road under axis* spinner box a value must be defined, which is > 0.

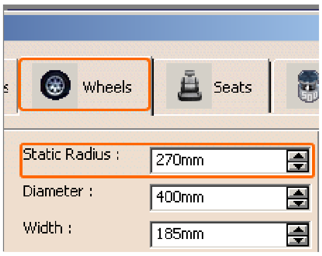
③ *Extent* check box with *Wheel radius* spinner box

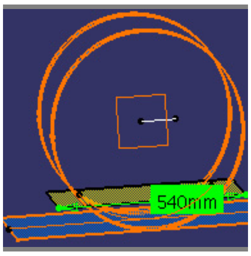
This check box controls the extension of the ground clearance limit geometry between the axes.

- If deactivated:

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

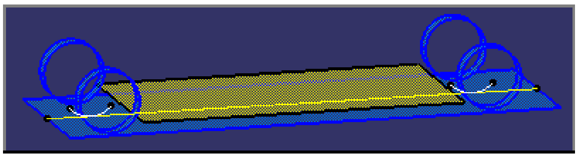
- If activated:





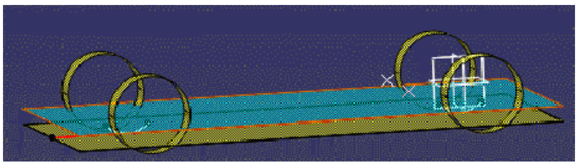
If the *Wheel Radius* option is gactivated, the extension is the double of the value, specified in the base data dialog box on the *Wheels* tab card ($2*R_{stat}$, i. e. r in positive *x*-direction plus r in negative *x*-direction).

④ *General Surface* option



If this option is activated, a surface is generated in the area between the front and back wheels is generated.

⑤ *Calculation for the whole vehicle length* option

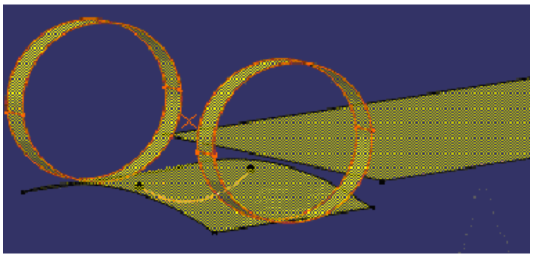


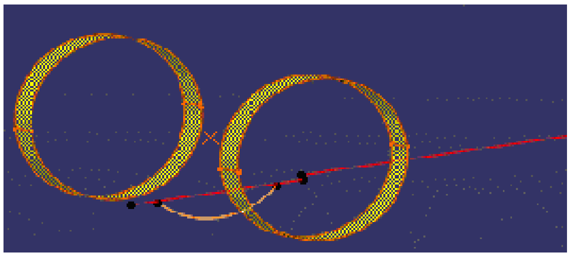
If this option is activated, the clearance line (or surface) will be generated for the total length of the vehicle (see fig.).

⑥ Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Surface* option
  The features are visualized as surface model.
- *Wire* option:
  The features are visualized as wire model.





It is also possible to activate both visualization modes.

- *Display current geometry* option
  See on page 38.

Required tab card

This tab card contains the required values for the distance of the clearance line to the road surface.

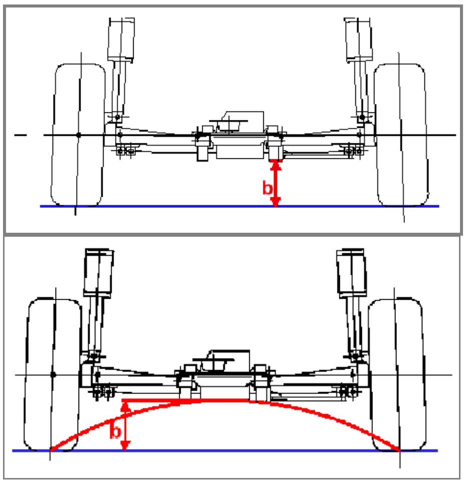
⑦ *Distance to road* spinner box

The *Distance to road under axis* spinner box is deactivated when the *Calculation under axis* option is deactivated.

This spinner box controls the distance *b* between the clearance line beneath axes and the road surface.

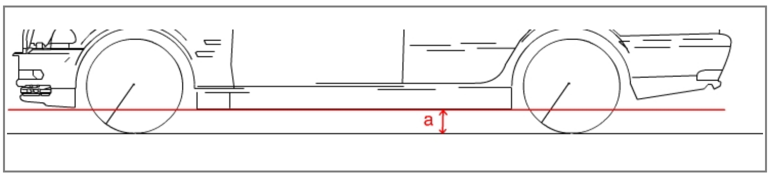
This value must be specified when the *Calculation under axis* option is activated.

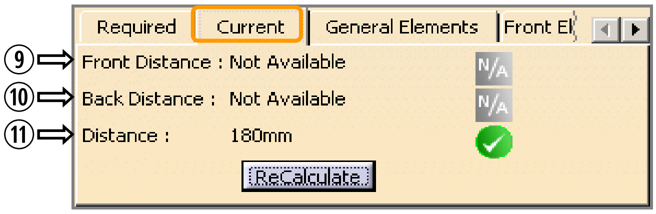
The *b* value may be set to 0 (what basically makes no sense). If the clearance line is calculated as circular arc (i.e. if the Circular option ② is activated), a warning message will be displayed saying that, in order to generate a circular arc, there must be a distance *b* > 0.



⑧ *Distance to raod* spinner

This spinner box controls the distance *a* between the clearance line and the road surface.





Current tab card

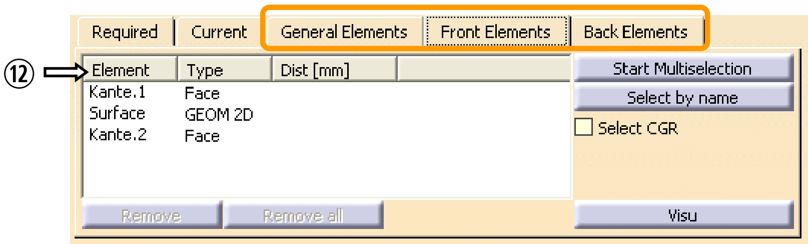
Measurement result output for Front Distance/ Back Distance / Distance

⑨ Front / Back distance
⑩

Distance from the selected feature to the front/back clearance line under axes. The distance is calculated vertically to the loading plane.

⑪ Distance

Distance from the selected feature to the ground clearance line between front and rear axles. The distance is calculated vertically to the road surface.



General Elements / Front Elements/Back Elements tab cards

On these tab cards, the features can be selected that are to be used to check the general / front / back ground clearance line; he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

⑫ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the general / front/ back ground clearance line. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

4.5 Inner Angle

The inner angle is the smallest angle between the two tangents at the front and rear wheel (generated with R_{stat}) with the intersection of the tangents touching the underfloor (see fig. below). The curve, resulting from the various intersections of the tangents with the same inner angle, serves as a target value for the underfloor.
The second calculation method at disposal is a segment of a circle with a radius

```
R = wheelbase / (2 * sin (alpha))
```

which lies tangential to R_{stat} of the front and rear wheel.

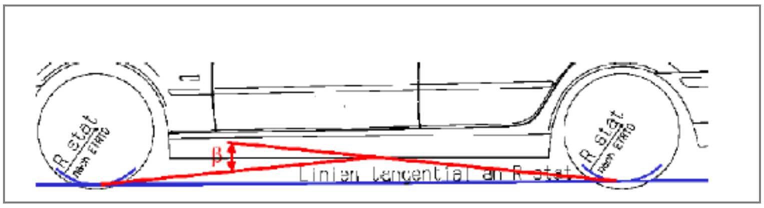
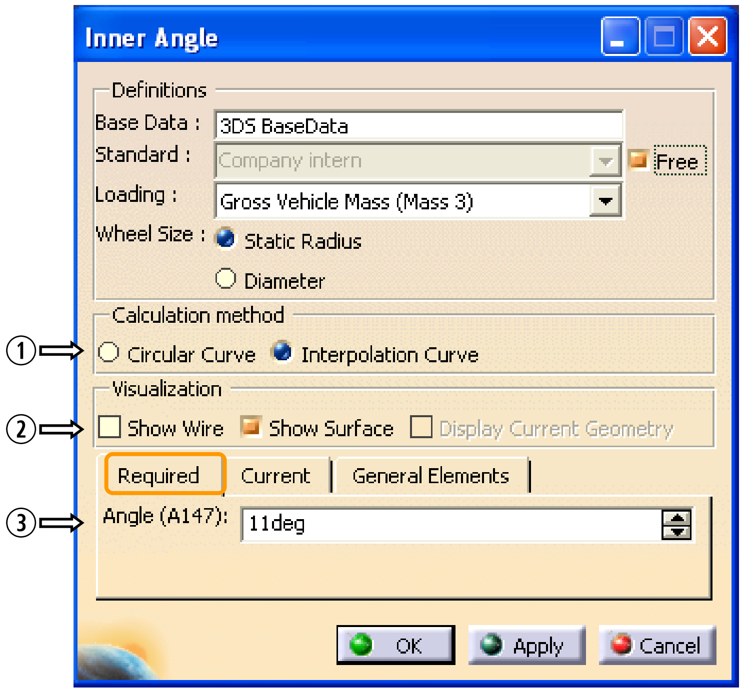


Fig.: Inner Angle (tangents)

With this function the user can create the aforementioned target curve (or surface) as well as calculate the actual value of the inner angle.

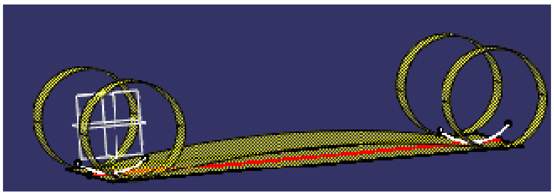
- **Specifications in the GUI**



① *Calculation method* radio buttons

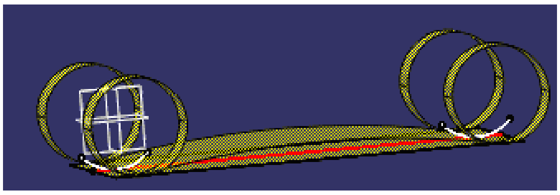
Here a calculation method for the inner angle can be selected.

- Circular curve



For the displacement curve is used a circular arc with constant radius, which is inserted tangentially between front and back wheel.

- Spline

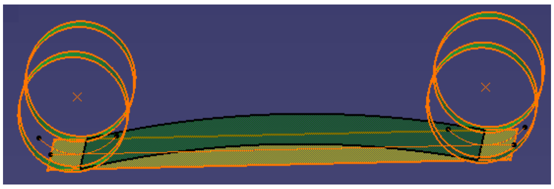


The displacement curve is generated as spline at discrete points, which is calculateed, using the angle, defined on the *Required* tab card). The curve generated with this method in general is less steep.

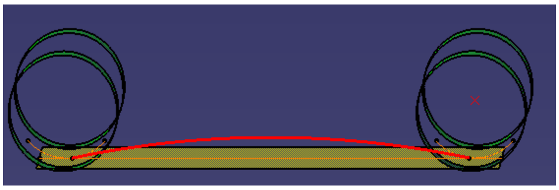
② Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Surface* option
  The features are visualized as surface model.



- *Wire* option:
  The features are visualized as wire model.



It is also possible to activate both visualization modes.

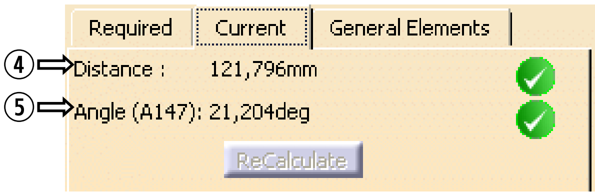
- *Display current geometry* option

See on page 38.

Required tab card

③ *Angle* spinner box

Here as required value for the inner angle the angle is to be specified, for which the selected feature(s) do(es) not clash with the required geometry.



Current tab card

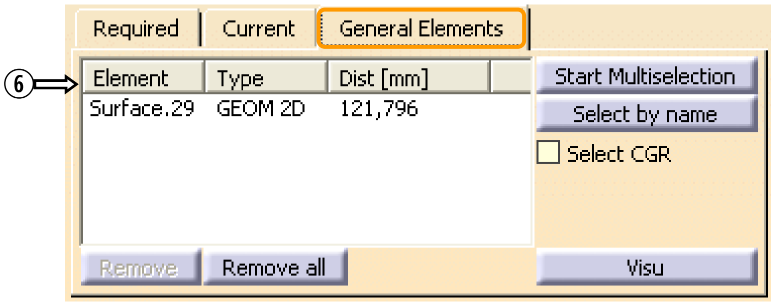
Measurement result output for Distance / Angle

④ Distance

Distance between the selected feature and the distance curve. The distance is measured vertically to the loading plane, and, thus, may slightly deviate from the measurement results of the CATIA measurement tool.

⑤ Angle

Here is displayed not the current value of the inner angle, but the maximum possible value for the inner angle, for which the selected feature(s) do(es) not clash with the field of the required geometry.



General Elements tab card

On this tab card, the features can be selected that are to be used to check the inner angle. (For detailed proceeding see CAVA User Manual—General, section "CAVA Measurements".)

⑥ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the inner angle. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section "CAVA Measurements".)

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

4.6 Oil Pan

The oil pan clearance line defines the boundary outline of the oil pan for the area of the front overhang. It consists of three lines (see fig.).

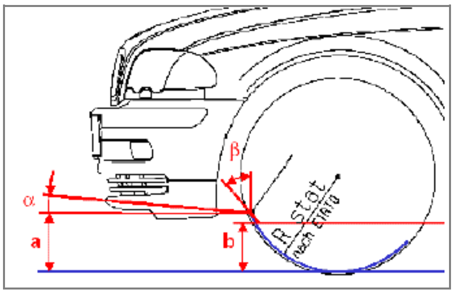
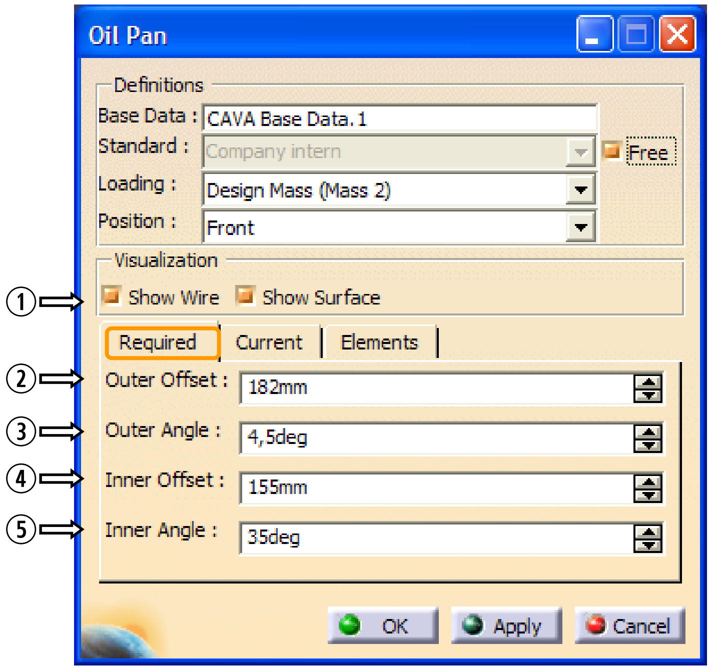


Fig.: Oil pan clearance line

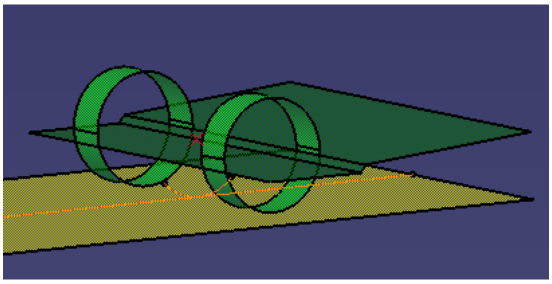
- **Specifications in the GUI**



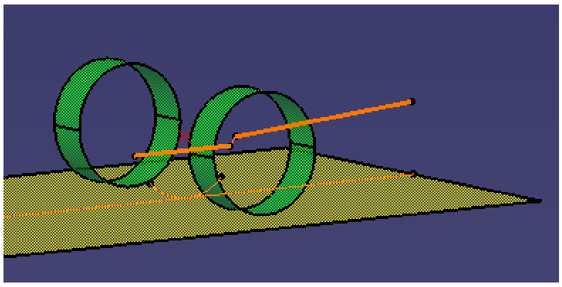
① Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Surface* option
  The features are visualized as surface model.

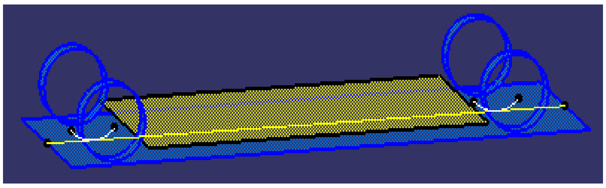


- *Wire* option:
  The features are visualized as wire model.



It is also possible to activate both visualization modes.

If the *Middle* position option has been selected, a line or surface is generated in the area between the front and the rear wheels with distance *b* (see below ④) to the loading plane.



Required tab card

Here the required values for the oil pan clearance must be specified.

② Outer offset

Distance *a* from loading plane to its parallel (see fig. above).

③ Outer angle

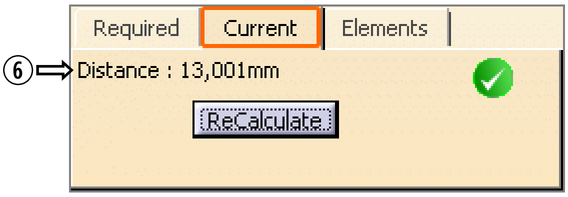
The vertex of the angle α is situated in the point of intersection between radius R_{stat} and the parallel to the loading plane (which have distance *a* between each other) and lies namely between this parallel and a line that runs forward up.

④ Inner offset

Distance *b* between the loading plane and the parallel to the latter.

⑤ Inner angle

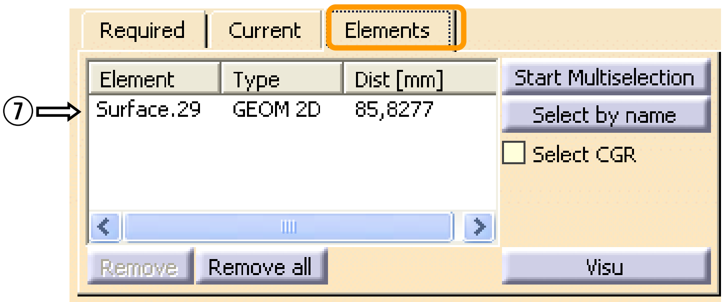
The angle α is situated at the vertical that runs through the point of intersection between radius R_{stat} and the parallel to the loading plane; its vertex lies at this intersection point up (see fig above).



Current tab card

⑥ Measurement result output for *Distance*

Vertical distance from the oil pan clearance line to the nearest feature. The value may be positive or negative.



Elements tab card

(For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.) With this tab card the features may be selected to be used to check the oil pan clearance.

⑦ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the oil pan clearance. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

4.7 Wheel Fixing

The *wheel fixing* function defines the areas in front of and behind the wheels, which need to remain clear to allow the fixing of the wheels during railway transport. The *Wheel Fixing* function allows the optical representation of these areas in the model. The areas can be displayed either as circle segment or as a cuboid.

- Segment 

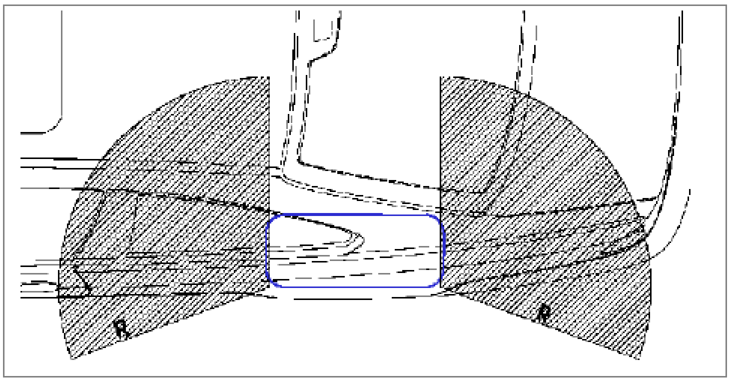
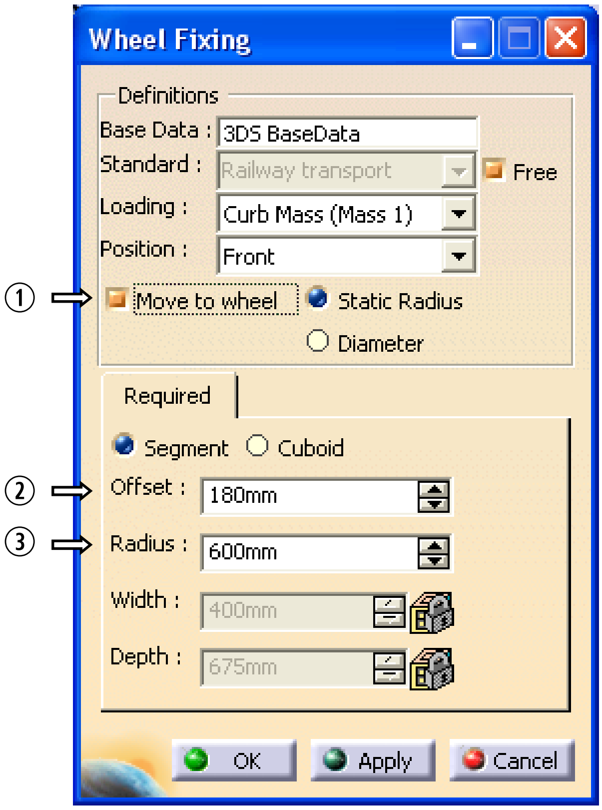


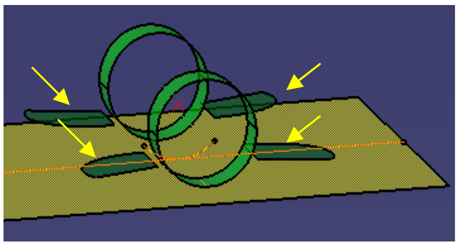
Fig.: Wheel Fixing
The hatched surfaces represent the areas that need to remain clear.

- Input



Visualization

The areas for the wheel fixings are visualized as surfaces.



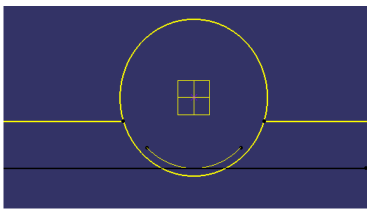
① Move to wheel

This option is only enabled in *Free* mode.
By default, the area for the wheel fixing is positioned at the theoretically widest dimension of the wheel (diameter).

If this option is enabled, the surface is positioned exactly at the wheel geometry from the base data.

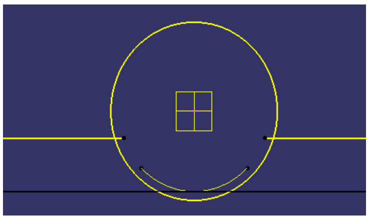
Static Radius

The wheel fixing surface is moved towards the wheel until it touches the static radius representation of the base data.



Diameter

The wheel fixing surface is moved towards the wheel until it touches the diameter representation of the base data.

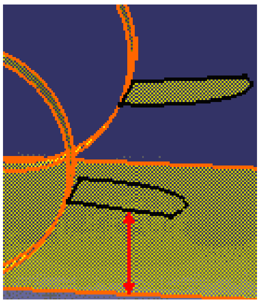


Required tab card

Here the required values for the front and rear wheel fixings are to be specified.

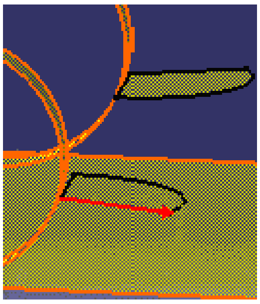
② Offset

Distance between wheel fixing plane and road plane (see red arrow). The position of the road plane depends on the selected loading.

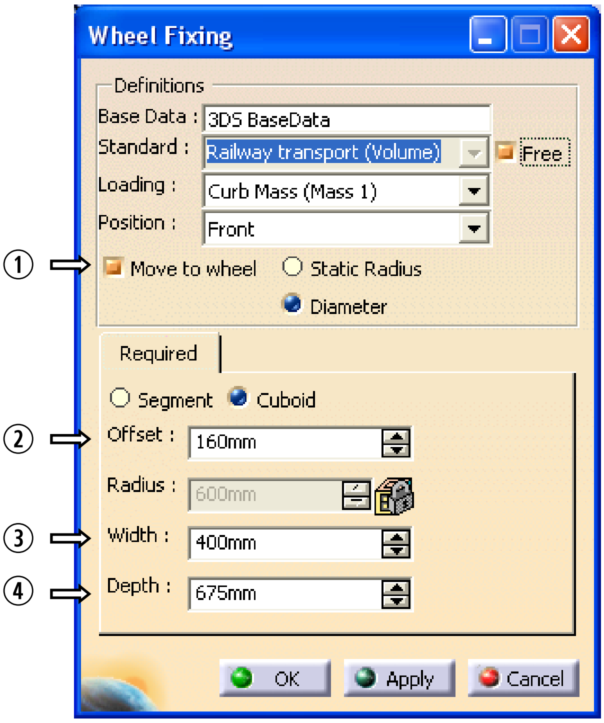


③ Radius

Radius of the circle segment of the wheel fixing area (see red arrow).

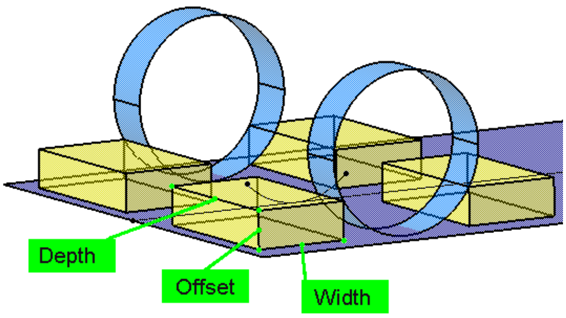


- Cuboid



Visualization

The areas for the wheel fixings are visualized as a cuboid.

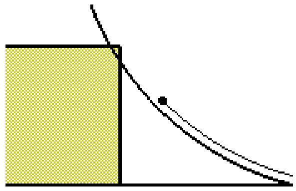


① Move to wheel

This option is only enabled in *Free* mode.
By default, the area for the wheel fixing is positioned at the theoretically widest dimension of the wheel (diameter)
If this option is enabled, the cuboid is positioned exactly at the wheel geometry from the base data.

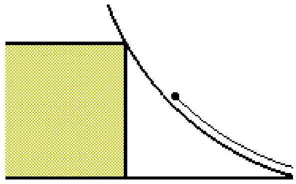
Static Radius

The wheel fixing cuboid is moved towards the wheel until it touches the static radius representation of the base data.



Diameter

The wheel fixing surface is moved towards the wheel until it touches the diameter representation of the base data.

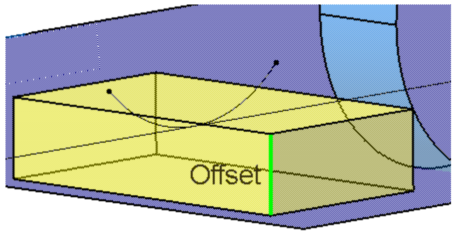


Required tab card

Here the required values for the front and rear wheel fixings are to be specified.

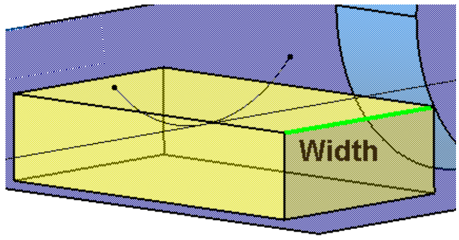
② Offset

Defines the height extension of the cuboid measured from the road plane. The position of the road plane depends on the selected loading.



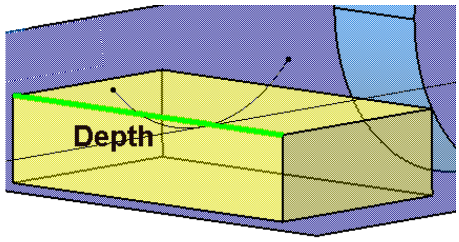
③ Width

Extension of the cuboid.



Depth

Extension of the cuboid.

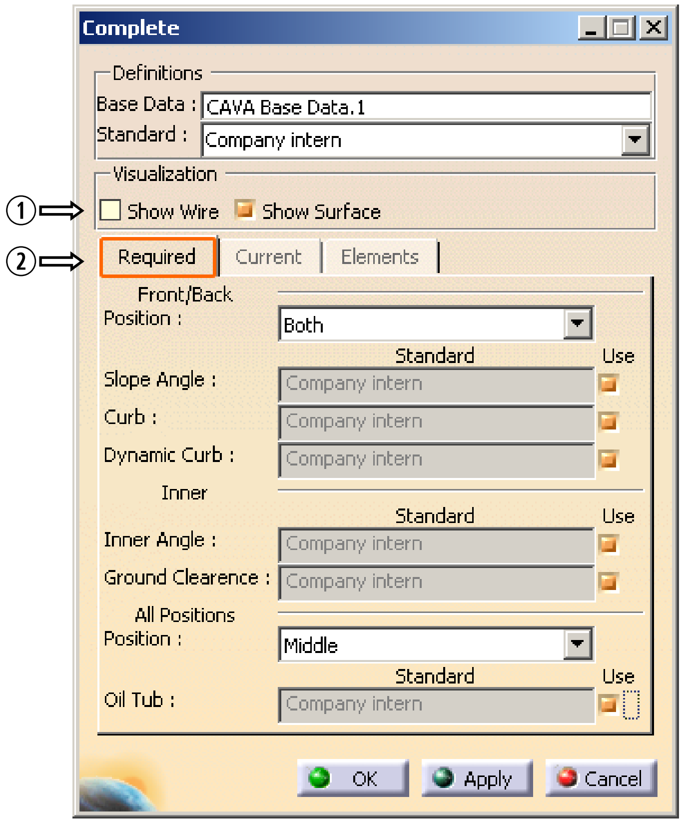


4.8 Underfloor Complete

This function creates a complexe boundary geometry, which comprises the following underfloor features:

- Slope Angle
- Static curb
- Dynamic Curb
- Ground Clearance *(without clearance underneath axes)*
- Inner Angle
- Oil Pan

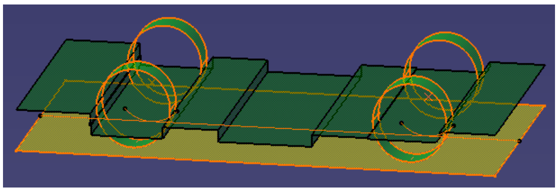
• Specifications in the GUI

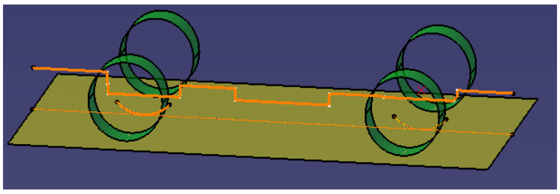


① Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Surface* option
  The features are visualized as surface model.
- *Wire* option:
  The features are visualized as wire model. The lines/curves are shown on the vehicle midplan.



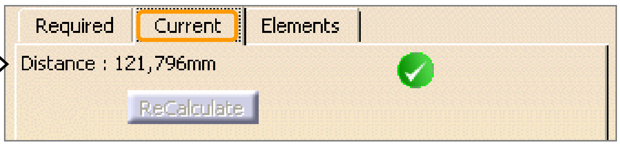


It is also possible to activate both visualization modes.

② *Required* tab card

Here, it can be selected which sub-functions are to be included in the complete underfloor clearance line. To include a function, the check box of the function must be activated. For all functions, only one unique standard may be used, which is to be selected in the *Standard* list box. It is not possible to use the *Free* mode. The extension of the underground clearance line (or clearance surface) depends from the maximum extension of the lines/surfaces of the activated individual checks and also from the breadth of the vehicle (lateral extension of the surface).

ATTENTION:
The definition of the used standards depends exclusively from the configuration file. If these different standards use different loading planes or or not, depends from the administrator settings.

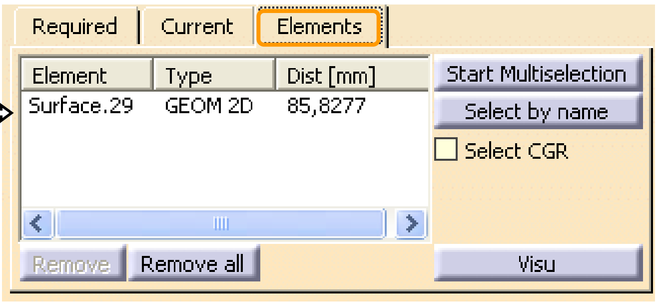
③ ⇨


Current tab card

Measurement result output for *Distance*

③ Distance

Vertical distance from the complete underfloor clearance line to the selected feature. If several geometries have been selected, the distance from the underfloor line to the nearest feature will be measured.
The distance is calculated vertically to the used loading plane. Thus, the result might slightly differ from that provided by the CATIA measuring tool.

④ 

Elements tab card

On these tab cards the features can be selected, which are to be used for checking the complete underfloor clearance.(For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

④ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the complete underfloor clearance. he tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

5. Lamp Positions

The CAVA *Lamp positions* function predefines, according to the standard selected for the different lamp types, the limit values for the installation positions and displays them in the model in form of a limiting grids.

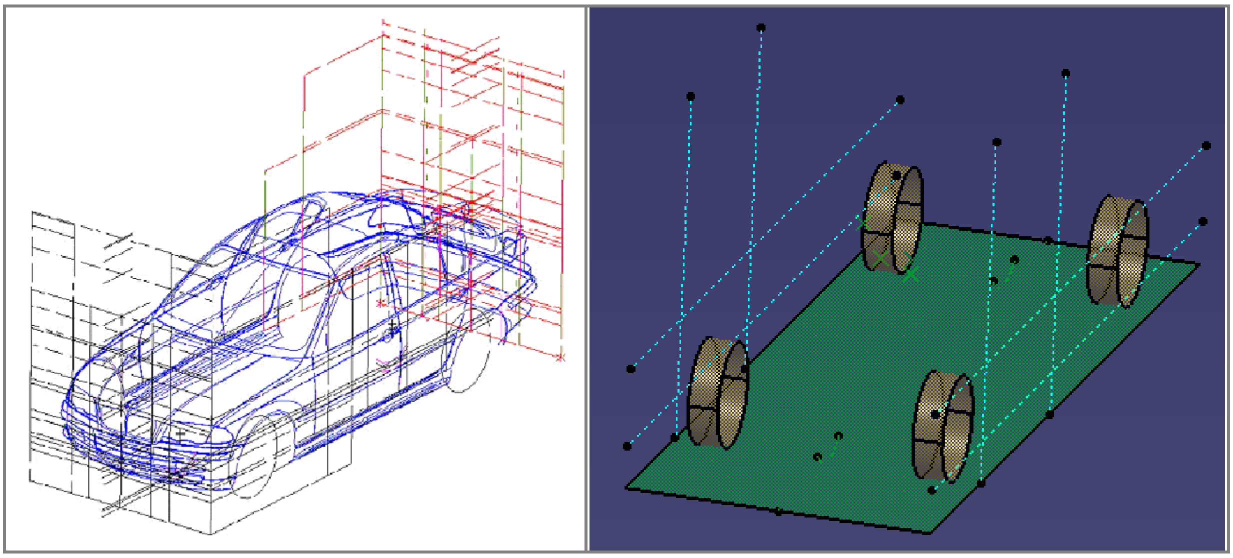
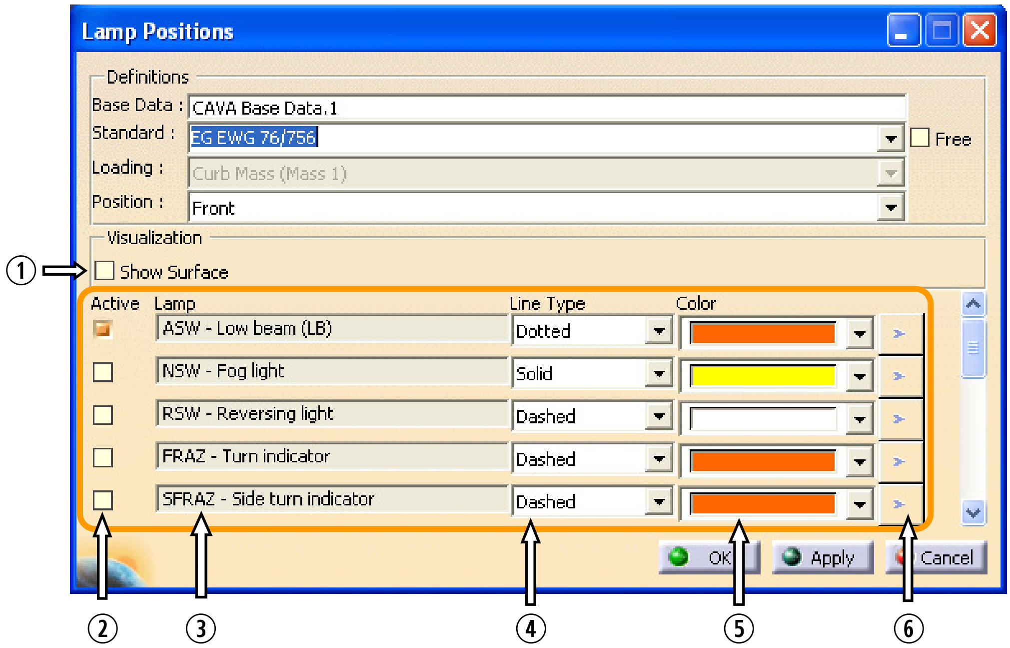


Fig.: Limiting grids for lamp positioning

The figure on the left shows a real working situation with a great number of grids for several types of lamps. The figure on the right shows for one type of lamp (side marker lamp) the limiting grid inside of which the lamps are to be installed.

The grid lines are displayed on the planes which stand vertically on the edges of the loading plane.
How many limiting lines will be indicated depends on the settings in the configuration file, that are based on the specifications of the respective standard for the respective lamp type. Some of the standards may contain no specifications for some of the lamp types. In this case, CAVA will display no grid lines.

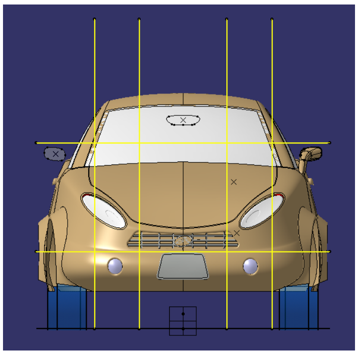
- Specifications in the GUI



① Show Surface

Unchecked:

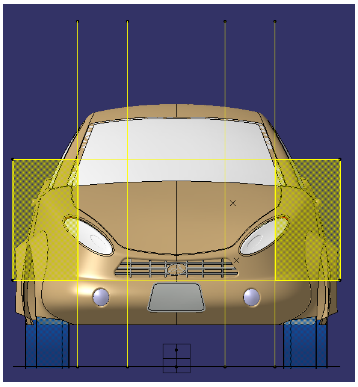
If this option is not selected the limits of the areas will be visualized by lines.



Checked:

Enable this check box if the areas of allowed lamp positions should be visualized as surfaces.

This option provides an easier interpretation of the limit boundaries.



② *Active* check box

The user can define (additively) for which lamp types the grid is to be displayed; the user can control for himself the orientation in the grids.

③ Lamp typ

In the *Lamp type* column the available lamp types are listed. The lamp types are defined in the `LampPositions.xml` configuration file.

The following table contains the lamp types defined in CAVA.

the list is given as example and is not obligatory; every user or the administrator can define its own lamp types with names of his own.

Type (German)	Abbraviation (example)	Type (English)	Abbraviation (example)
Fernlichtscheinwerfer	FSW	High beam	HB
Abblendlichtscheinwerfer	ASW	Low beam (LB)	LB
Nebelscheinwerfer	NSW	Fog light	FL
Rückfahrscheinwerfer	RSW	Reversing lights	DBL
Fahrtrichtungsanzeiger	FRAZ	Turn indicator	TS
Seitlicher Fahrtrichtungsanzeiger	SFRAZ	Side turn indicator	LTS
Warnblinklicht	WBL	Warning lights	WL
Bremsleuchte	BL	Brake lights	BL
Hochgesetzte Bremsleuchte	HBL	3rd brake light	TBL
Begrenzungsleuchte	BGL	Running light	RL
Schlussleuchte	SL	Tail light	TL
Nebelschlussleuchte	NSL	Rear fog light	RFL
Parkleuchte	PL	Parking light	PL
Hinterer nicht dreieckiger Rückstrahler	HRS	Rear non triangular reflector	RR
Vorderer nicht dreieckiger Rückstrahler	VRS	Front non triangular reflector	FR
Seitlicher nicht dreieckiger Rückstrahler	SRS	Side non triangular reflector	SR
Seitenmarkierungsleuchte	SML	Side marker lamps	SML
Tagfahrleuchte	TFL	Daytime running light	DTRL

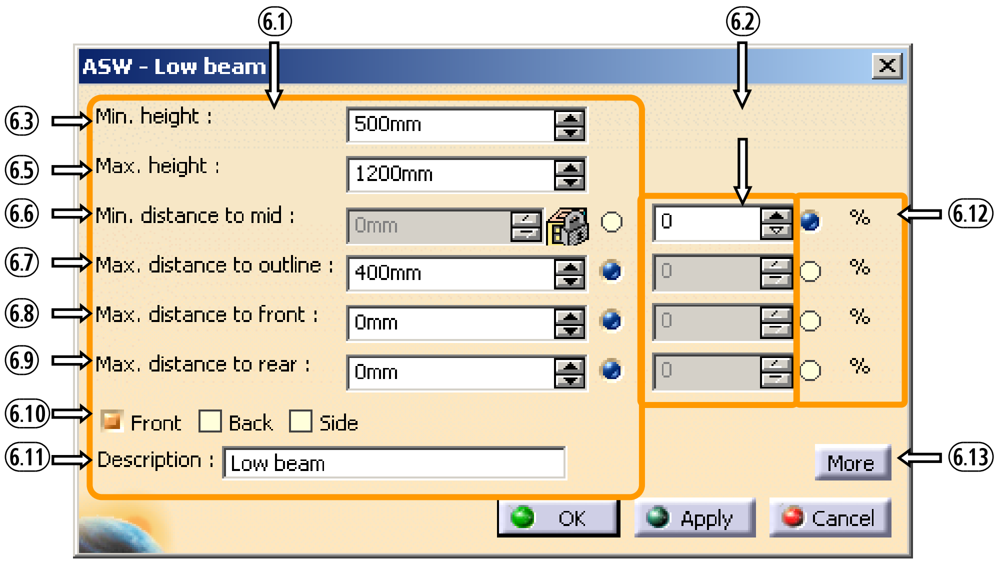
④⑤ *Line type and color* list boxes

For make the lamp types distinguishable, the user can select between different line types and colors for the representation of the grid lines. The range of colors comprises all colors that are available in CATIA.

Line type and line color can be changed by the user once the lamp type has been activated. This is possible even if the *Free* option is not activated.

⑥ *Arrow* button [>]

Click on the *Arrow* button to open the value definition dialog box for the lamp type (see fig. below). The dialog box is the same for all lamp types.



6.1 Definition of the absolute parameters

6.2 Definition of the percent parameters

If the respective percent option “%” 6.12 is active, the values for minimum distance to mid, maximum distance to outline, maximum distance to front and maximum distance to rear may be specified in percent—absolute and percent parameters are alternative options.

The specified percent value relates to the vehicle length (L103) or to the vehicle width (W103), defined in the Base Data.

If the parameter `0.0` is specified, no limiting line will be displayed. This allows to deactivate the representation of grid lines.

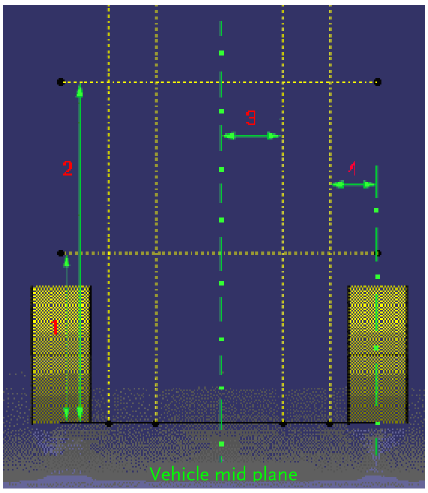


Fig.: Lamp positions – absolute parameters

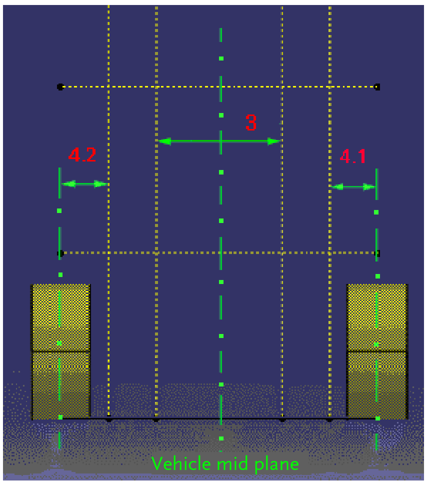


Fig.: Lamp positions – percent parameters

For explications to the red figures see the table below.

	Absolute Parameters	Percent Parameters
6.3	Min. heigth (1) Minimum distance to the road surface.	–
6.5	Max. heigth (2) Maximum distance to the road surface.	–
6.6	Min. distance to mid (3) Distance to the vehicle mid plane. The specified distance value is used to draw two grid lines as parallels to the vehicle mid plan—one in negative and one in positive distance.	Min. distance to mid (3) The specified percent distance value is used to draw two grid lines as parallels to the vehicle mid plane—the half of the value generates the distance in negative direction, the other half the distance in positive direction.
6.7	Max. distance to outline (4) Distance between outer edge of the vehicle to midplane	Max. distance to outline (4.1;4.2) The specified per cent value is marked out *to one half* starting from the right vehicle outer edge to the midplane (4.1) and *to the other half* from the left vehicle outer edge to the midplane (4.2). (Example: For a specified value of 20 % with a vehicle width of 1700 mm, 170 mm are marked out from the right edge and 170 mm from the left edge respectively.
6.8	Max. distance to front Distance from the front edge of the vehicle to the mid plane of the vehicle (positive *x*-direction). (Displayed if lateral lamp positions are activated.)	Max. distance to front Distance from the front edge of the vehicle in the negative *x*-direction as a percent value from the vehicle length (L103)—for the side lamps.
6.9	Max. distance to rear Distance from the rear edge of the vehicle to the mid plane of the vehicle (negative *x*-direction) (Will be displayed on CATIA workspace only if the *Side* position check box 6.10 is activated because the maximum distance to rear is to be defined only for lamps, positioned laterally.)	Max. distance to rear Distance from the rear edge of the vehicle in positive *x*-direction as a percent value from the vehicle length (L103)—for the lamps fitted on the sides.

Absolute Parameters	Percent Parameters

6.10 Position check boxes

- Front

If this check box is actived, the specified values will be displayed for the front side of the vehicle.

- Back

If this check box is actived, the specified values will be displayed for the back side of the vehicle.

- Side

If this check box is actived, the specified values will be displayed for the lateral sides of the vehicle.

6.11 Description

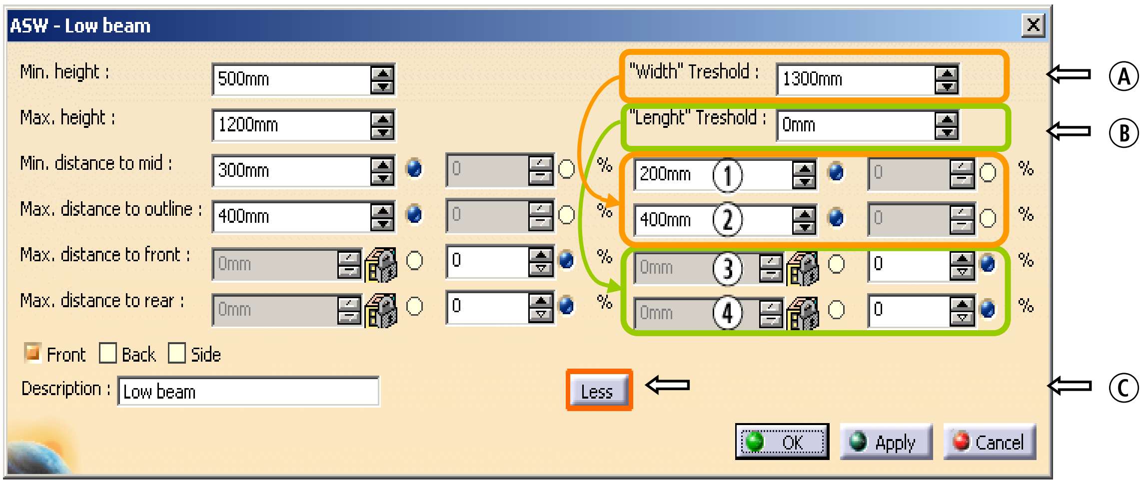
Here a short description for the lamp type can be entered.

6.12 *%* radio buttons

See 6.2.

6.13 *More* button

Click on the *More* button to extend the specification possibilities (see fig. below).



Ⓐ ① ② Width Threshold

If the width of the vehicle is lower than the value specified for “Width” threshold, for *Min. distance to mid* and *Max. distance to outline* the values defined in the boxes ① and ② will be used (or, depending on the selection, the respective percentage value). In this case the distance values specified on the left (6.6 to 6.9) will be not applied.

Ⓑ ③ ④ **Length Threshold**

If the length of the vehicle is lower than the value specified for “Length” threshold, for *Max. distance to front* and *Max. distance to rear* the values defined in the boxes ③ and ④ will be used (or, depending on the selection, the respective percentage value). In this case the distance values specified on the left (66 to 6.9) will be not applied.

Ⓒ ***Less*** **button**

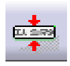
Click on the *Less* button to hide the *"Width" threshold* and *"Length" threshold* options.

NOTE

Hiding will not deactivate the specificatrions. The values defined there will be applied in any case!

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

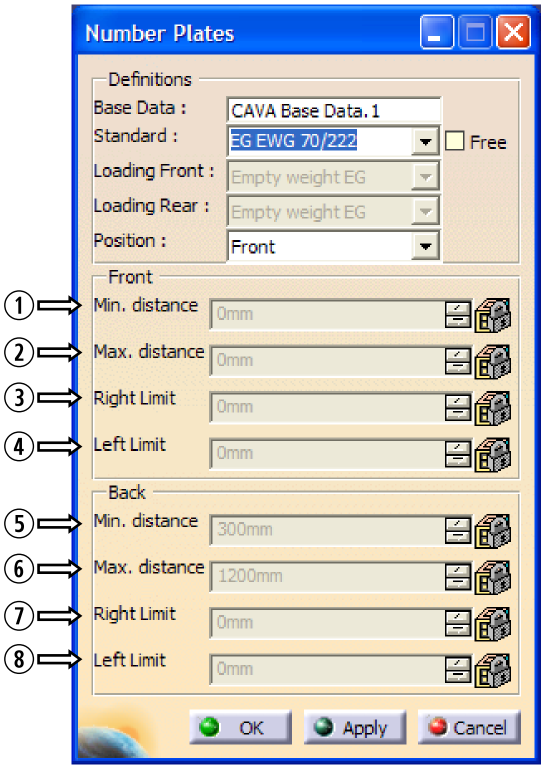
6. Number Plates

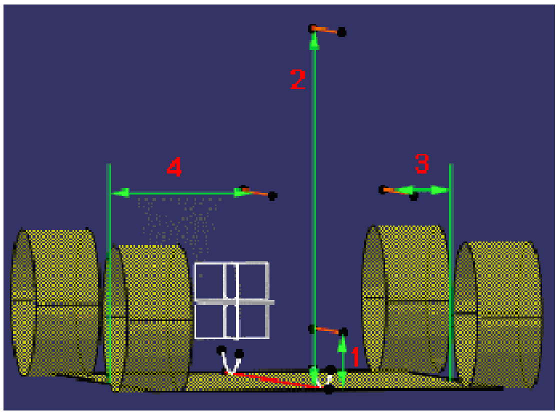


The CAVA *Number plate* function defines and displays in the model, according to the specifications of the selected standard, the limiting lines to be observed for the fixation of the number plate—minimum and maximum height, minimum distances from the right and left outer edge of the vehicle.

• Specifications in the GUI

For this CAVA function you can select a separate loading plane for the front and the rear.





The values, specified here for the limiting lines, will be displayed in form of 500 mm long lines. Their extension from the front or back boundary of the loading plane is 250 mm in both positive and negative x direction. This length is defined by CAVA and can not be changed by the user.

①⑤ *Min. distance* spinner box

Minimum distance to the loading plane (1) , measured at the frontmost point of the centerline of the loading plane (1). (For the back number plate the distance is measured at the backmost point.)

②⑥ *Max. distance* spinner box

Maximum distance to the loading plane (2) , measured at the frontmost point of the centerline of the loading plane (1). (For the back number plate the distance is measured at the backmost point.)

③⑦ *Right limit* spinner box

Distance from the right edge of the vehicle to the mid plane of the vehicle (3).

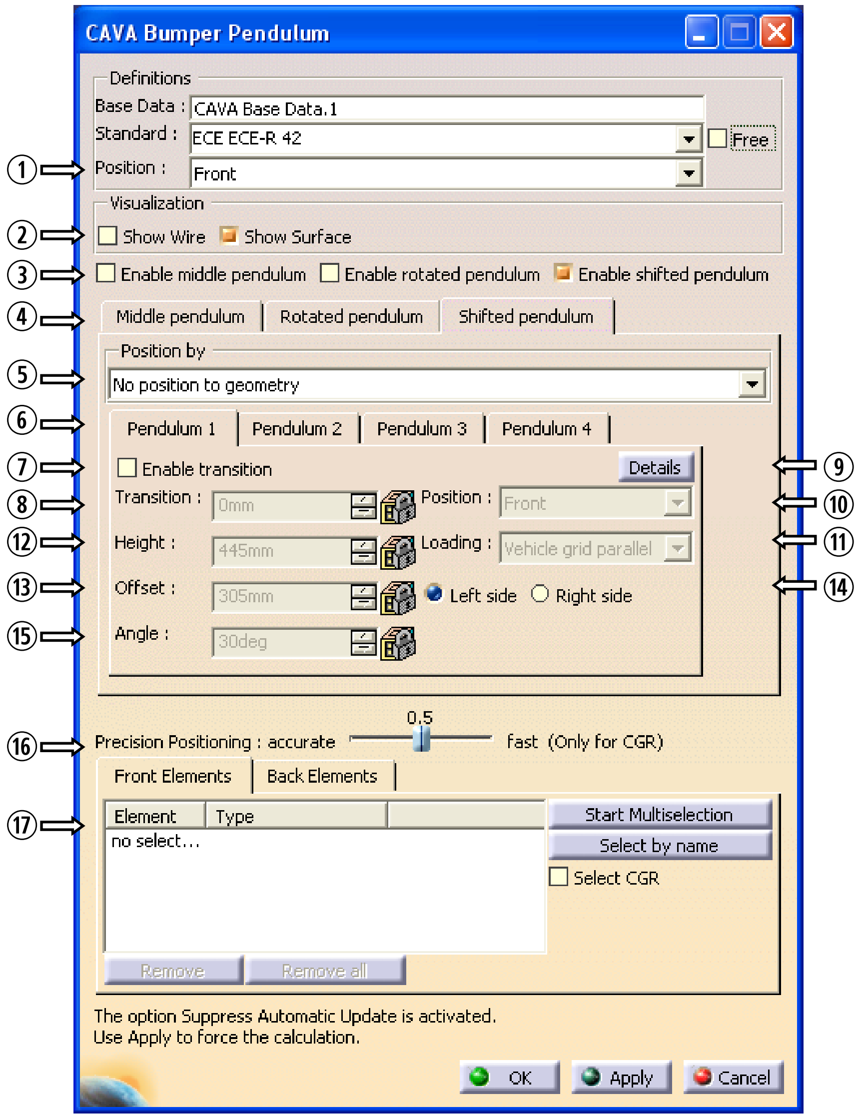
④⑧ *Left limit* spinner box

Distance from the left edge of the vehicle to the mid plane of the vehicle (4).

7. Bumpers

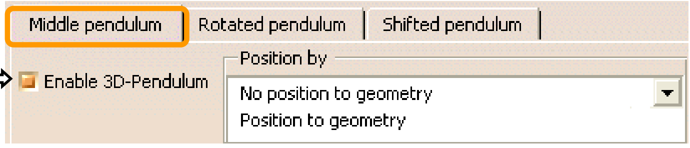
The CAVA BUMPERS function helps the user to vertically position the bumbers, according to the specifications of the international standards. For that purpose, in the model a test profile is displayed to which the bumper can be aligned. The test profile has a geometry analogous to the bumper test pendulum, which is used in practice to test bumpers by crashing them on a defined height over the road surface.

- ## Specifications in the GUI



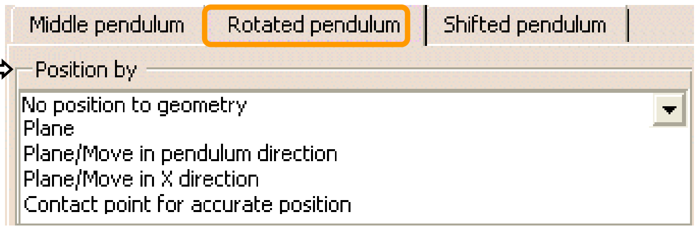
The options mentioned for item ⑤ depend from the used pendulum type.

5.1 ⇒

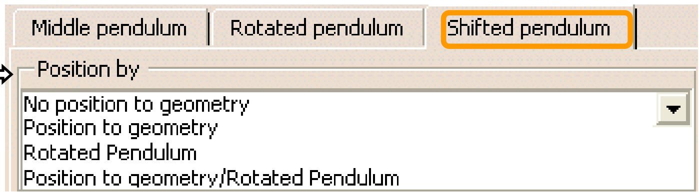


⇐ 5.2

5.3 ⇒



5.4 ⇒



① *Position* list box

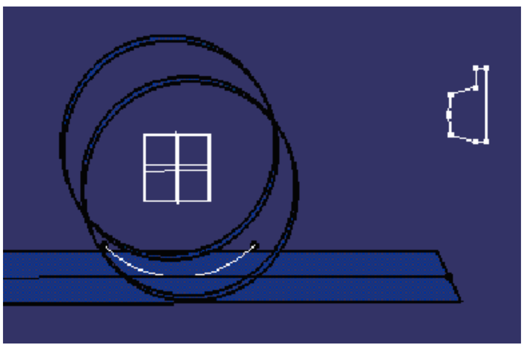
The selection in this box controls which of the pendulums will be represented in the model.

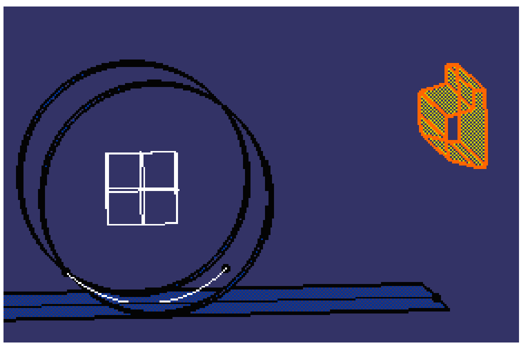
- *Front* The function is operated only for the front part.
- *Back* The function is operated only for the rear part.
- *Both* The function is operated for both front and rear parts.

② Check boxes for visualization

Depending on the selected visualization mode, the features in CATIA workspace are visualized differently:

- *Wire* option: The features are visualized as wire model.
- *Surface* option The features are visualized as surface model.





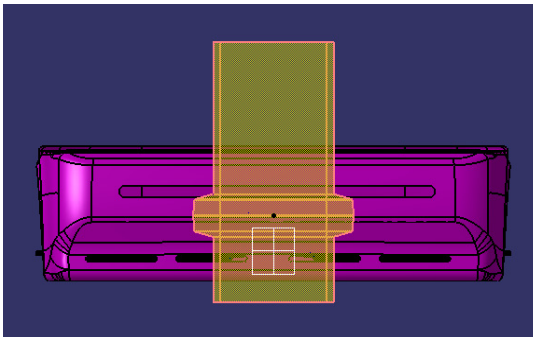
It is also possible to activate both visualization modes.

③ Check box to activate the pendulum type

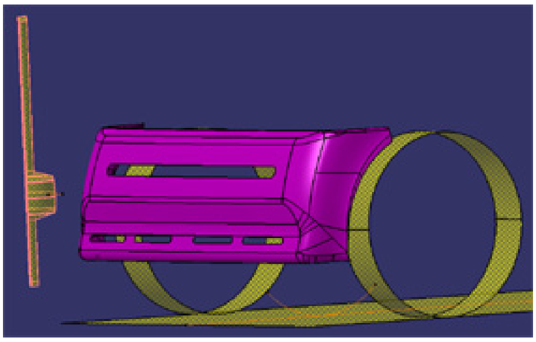
Select the pendulum type(s) that should be created. You have to activate the pendulum type here before you can define the values for it/them in the respective tab page(s).

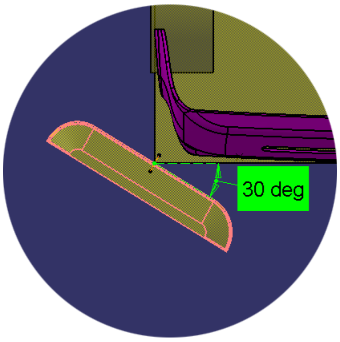
④ Tab pages to define the different pendulum types

- Middle pendulum
  If this check box is activated, the test pendulum is represented in the center of the front / back end of the vehicle.

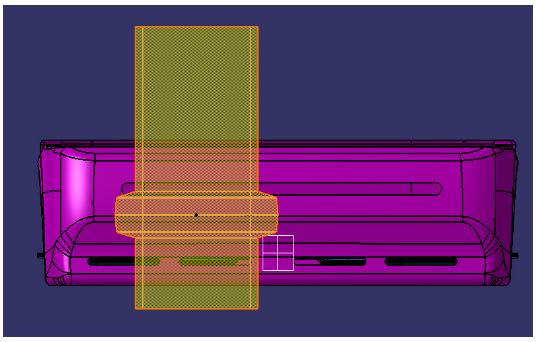


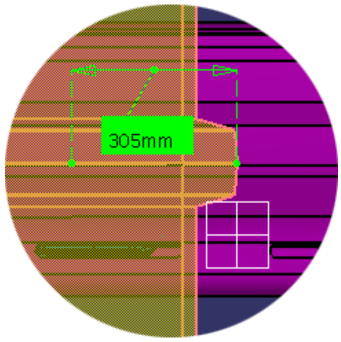
- Rotated pendulum:
  Visualization of the pendulum rotated 30 deg to the vehicle front (see figure below).





- Shifted pendulum:
  Visualization of a pendulum that is shifted in *y* direction. By default the shift is 305 mm measured from the vehicle mid plane to the mid plane of the pendulum. The value can be changed in „Free“ mode. Use only positive values for the shift, as the direction is controlled separately by the „Left Side/Right Side“option (see ⑭).

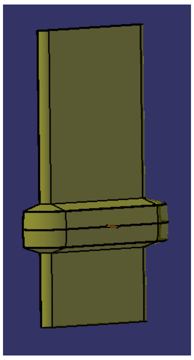


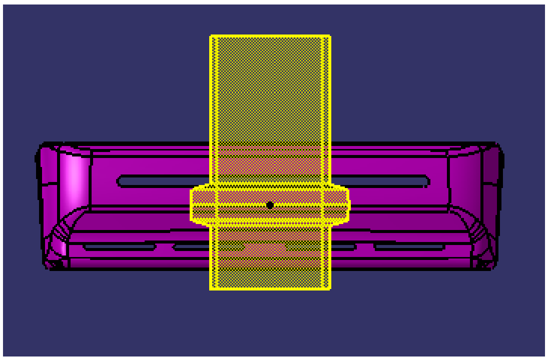


5.1 Checkbox „Enable 3D-Pendulum“

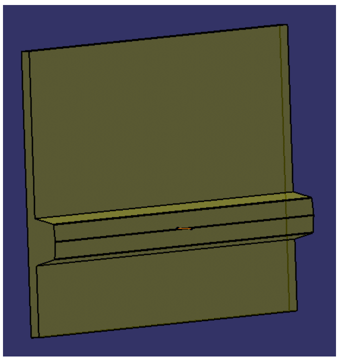
▶ For middle pendulum ◀

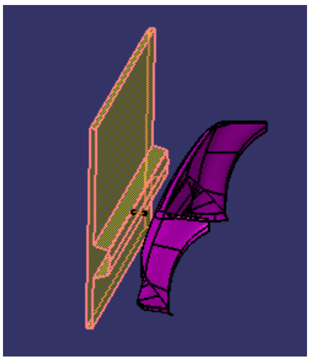
If this option is enabled, the pendulum will be created in the middle of the vehicle with the complete geometry as it is defined in the standard.





If the option is disabled, the pendulum will be created in a less complex visualization for the whole vehicle width.



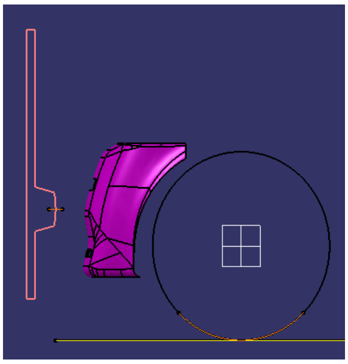


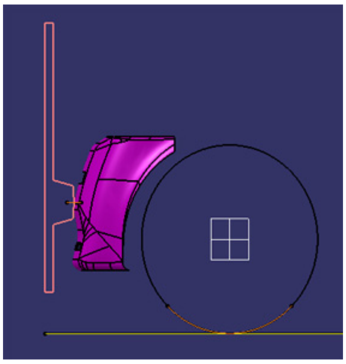
⑤2 Listbox „Position by“

▶ For middle pendulum ◀

• „No position to geometry“
The pendulum will be positioned to the front and/or rear overhang defined in the CAVA Base-Data feature.

• „Position to geometry“
The pendulum will be positioned to the vehicle geometry selected in the list (⑰).



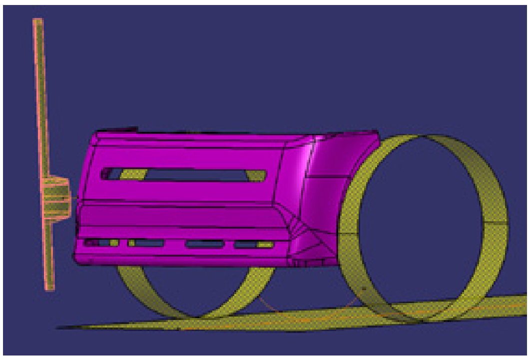


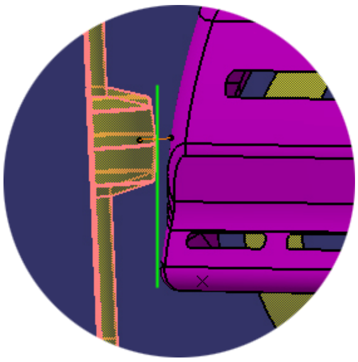
⑤3 „Position by“ list box

▶ For rotated pendulum ◀

• „No position to geometry“
The pendulum will be positioned to the front and/or rear overhang defined in the CAVA Base-Data feature.

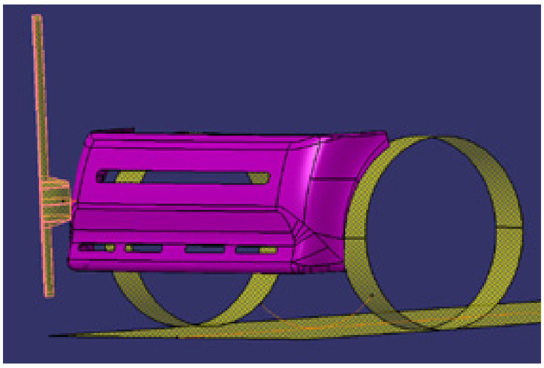
• “Plane”
A vertical plane is created at the outer most contour point of the selected geometry. The pendulum is then positioned to this plane.

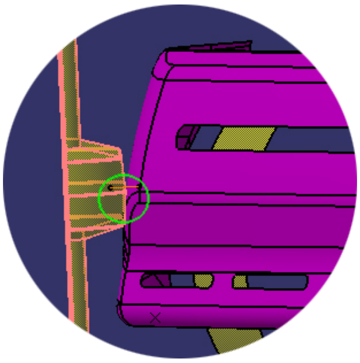


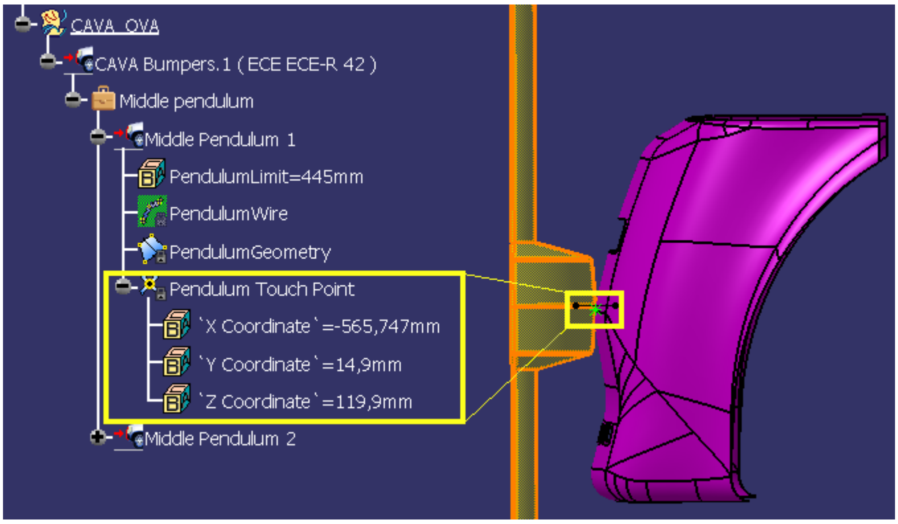


• “Plane/Move in pendulum direction”
When using this option, the pendulum is first positioned to a vertical plane at the outer most contour point of the selected geometry and then moved in pendulum direction towards the bumper geometry.
The contact point of the pendulum with the selected vehicle geometry is visualized separately. In the structure tree you will also find the coordinates of this point as parameter values (see figure below).

• “Plane/Move in x- direction”
When using this option, the pendulum is first positioned to a vertical plane at the outer most contour point of the selected geometry and then moved in x- direction towards the bumper geometry.
The contact point of the pendulum with the selected vehicle geometry is visualized separately. In the structure tree you will also find the coordinates of this point as parameter values (see figure below).







• “Contact point for accurate position”
According to the standard, the pendulum has to be positioned (in top view) to have the mid of the pendulum at the contact point for each height. This means that in top view the general position of the pendulums mid could be different in different height about the road plane (always 30 deg).

When calculating the pendulum with the *“Contact point for accurate position”,* the contact point for each height will be calculated temporarily with an unlimited pendulum. Later on it is positioned on the exact shape according to this point.

If there are several points, the most inward point (in *y* direction) will be taken.

⑤⁴ „Position by“ list box

▶ For shifted pendulum ◀

• „No position to geometry“ and

• „Position to geometry“
See ⑤²

• “Rotated pendulum”
The position of the shifted pendulum is in contact to the geometry of the rotated pendulum. Starting from the y coordinate of the contact point of the 30deg pendulum, the pendulum is shifted by a defined offset value in inward direction. The default value is 305mm and can be changed by the user in “Free” mode.

• “Position to geometry/Rotated pendulum”
The position of the shifted pendulum is in contact to the geometry of the rotated pendulum. Starting from the y coordinate of the contact point of the 30deg pendulum the pendulum is shifted by a defined offset value in inward direction. The default value is 305mm and can be changed by the user in “Free” mode.
Afterwards the Pendulum is positioned to the selected geometry.

⑥ Tab cards for the different test pendulums

In the pendulum test, the pendulum must impact the bumper at a certain height. The predefined height values are related to specified loading planes. Some of the standards prescribe one height parameter, which applies for two different loading planes (e. g. EU standard); other standards prescribe two height parameters for one loading plane (e. g. US standard).
On the four tab cards the parameters are defined for the respective pendulums (1 and 2 for the front end, 3 and 4 for the back end)—for height ⑫, position ⑩, loading plane ⑪, test-pendulum profile ⑨. This enables the user to integrate the requirements of different standards:

- for the EU standard by the means of a combination, consisting of one test-pendulum profile and two different loading planes;
- for the US standard by the means of a combination, consisting of two test-pendulum profiles, used each with the identical loading plane.

Which one of the predefined combinations will be used in the model depends on the selection in the *Position* list box ①—whether *Front*, *Back* or *Both* has been selected. According to this the profiles will be represented in the model.

⑦⑧ *“Enable Transition”* check box *a*nd
„*Transition*“ spin box

If the “Enable Transition” option is activated, the pendulum will be shifted in x direction. The length of the shift is defined by the value in field ⑧. (For the frontal pendulum the shift is in positive x direction, for the rear pendulum in negative x direction.

⑨ 

This button opens a dialog window for the definition of the pendulum profile (see fig. below).

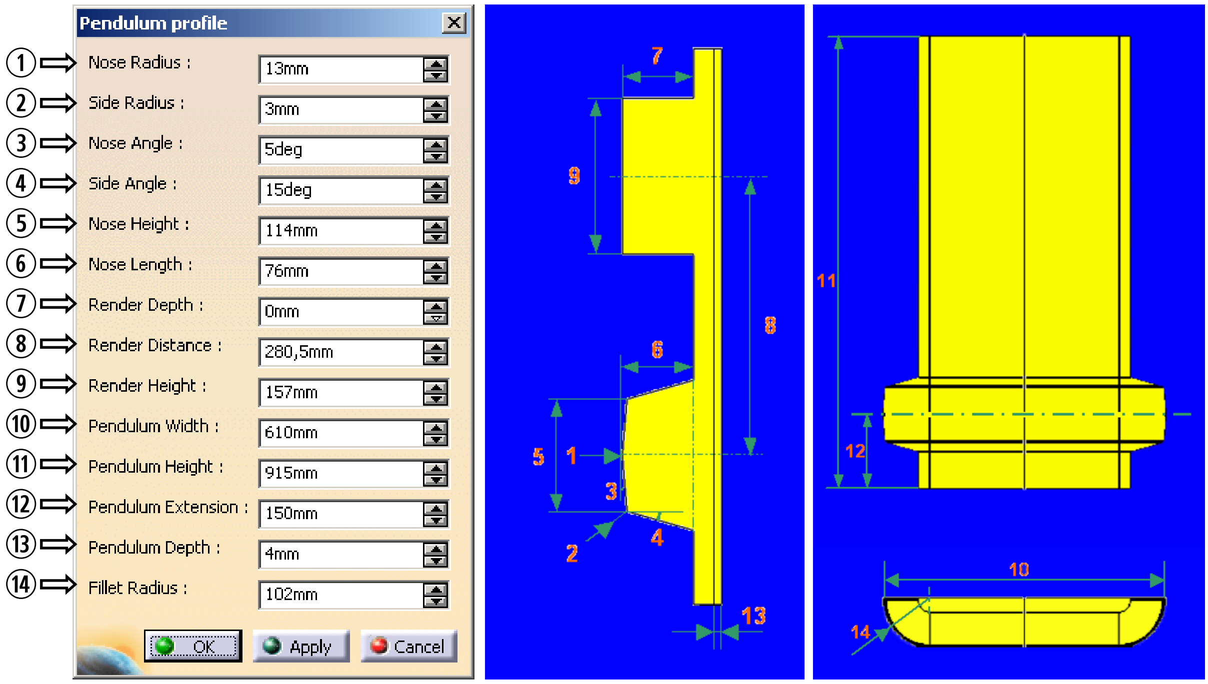


Fig.: Pendulum profile dialog box
The numbers in the list boxes on the left correspond to the numbers on the views of the test profile on the right.

⑩ *Position* list box

Under *Position* the position of the test profile on the car is defined.

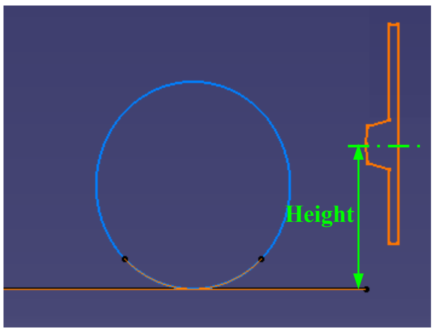
- *Front:* The pendulum is generated at the front end of the vehicle.
- *Back:* The pendulum is generated at the back end of the vehicle.

⑪ *Loading* list box

The list box contains all loadings that are activated in the base-data dialog box on the *Loadings* tab cards—*Preconfigured Loadings* and *User-Defined Loadings* tab cards. The loading planes that can be used for the selected standard are pre-defined by the standard and can be modified by the user only in *Free* mode.

⑫ *Height* check box

This spinner box defines the distance from loading plane to centerline of the test profile.



⑬ Offset

This option is available only for the shifted pendulum!

This value defines the shift of the pendulum. It is measured from the vehicle mid plane to the pendulum mid plane. It is 305 mm by default (given from the standard) and can be changed by the user in "Free" mode.

⑭ Left Side / Right Side

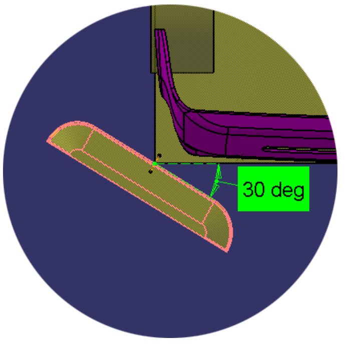
This option is available only for the rotated and the shifted pendulum!

With this option you can define for which vehicle side the pendulum should be created. In case of the shifted pendulum you control the direction of the shift so that you do not need to define negative values in the field for the shift length.

⑮ *Angle*

Angle value that is used to rotate the pendulum against the vehicle front (see fig. to the right).

Default value is 30 deg (given by the standard).



For the "rotated pendulum" the angle can be changed only in *Free* mode.

For the "shifted pendulum" you have to activate the "position by rotated pendulum" option to change the value (this setting is independent from the settings in the "rotated pendulum" tab page.). You have also to select the "position to vehicle geometry" option for the visualization of the different angles of the pendulum in the workspace. This is necessary to place the pendulum in the correct position.

⑯ Slider Precision Positioning

Use the slider to set the accuracy of positioning the pendulum to the geometry. This option works only for CGR geometry that is selected as Bumper geometry in the list for front and back elements. The precision of the positioning is determined by the more (accurate = 0) or less (fast = 1) exact tessellation. An accurate positioning will take a longer computing time.

⑰ *Front Elements/Back Elements* tab cards

Select here the the geometry elements with which the test pendulums will be in contact (cf. ⑤).

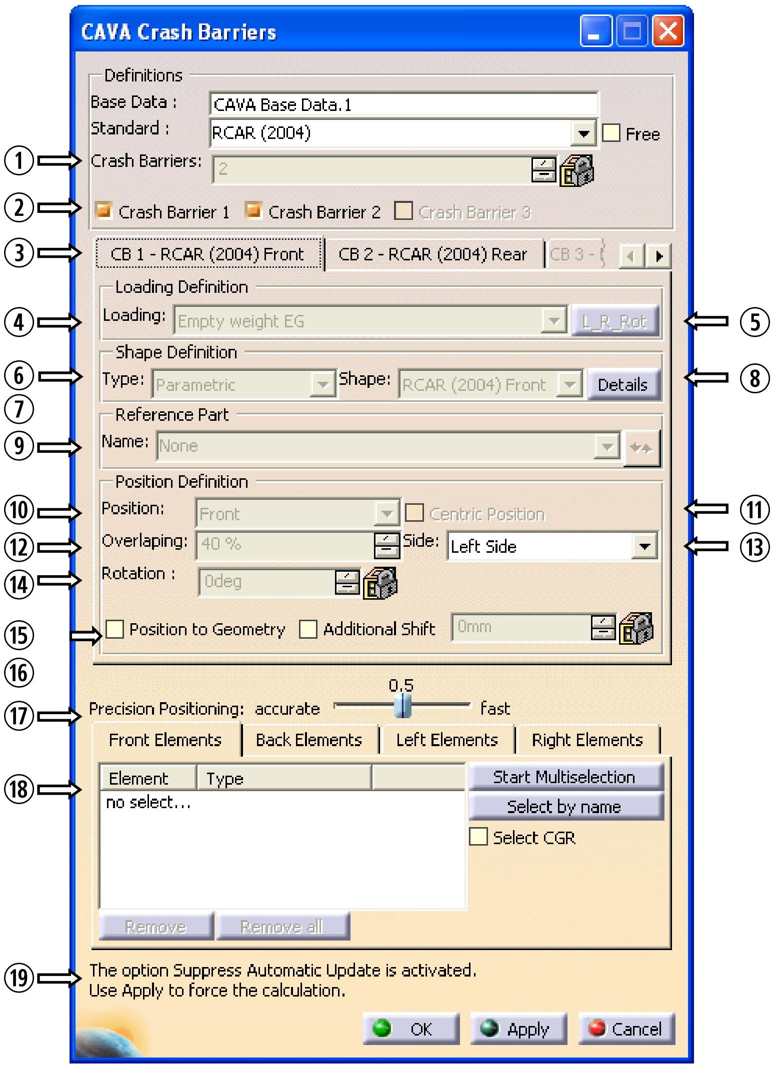
For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 25 ff.

8. Crash Barriers

The CAVA "Crash Barriers" function enables the user to position bumper barriers for a real crash test according to the standards. These test procedures should assess the bumper performance to prevent cosmetic damage in low speed crashes and, particularly, their ability to prevent the underride and override that often leads to severe cosmetic damage to non-structural parts such as lamps, grills, fender and bonnet/hoods or damage to expensive mechanical parts (e.g. air condition condensers).

For this purpose the **R**esearch **C**ouncil for **A**utomobil **R**epairs (RCAR) has defined different geometries for crash barriers in certain positions to do crash tests on real cars.

- ## Eingaben



① Crash Barriers

Number of crash barriers. This is determined by the selected standard.

② Activate the particular barriers

You can activate as many barriers as defined in field ①.

③ Tab cards of the crash barriers

With the crash barrier is activated (see ①), you can specify the values that are not predefined by the standard.

④ Loading

Loading used to define the road plane. This value is given by the standard and referenced from the CAVA base data.

⑤ L_R_Rot

Use this button to rotate the loading plane to the left or right around the *x* axis.

Please note:
In the current version, this button is deactivated because there is no standard implemented that supports this functionality.
(In order to activate the button, a special keyword needs to be set in the CAVA configuration).

⑥ Shape Type

This field describes the procedure used to create the barrier geometry. At the moment all barriers are defined by parameters. It is also feasible to use a reference part from which the geometry of the barrier is read out by the application (see point ⑨).

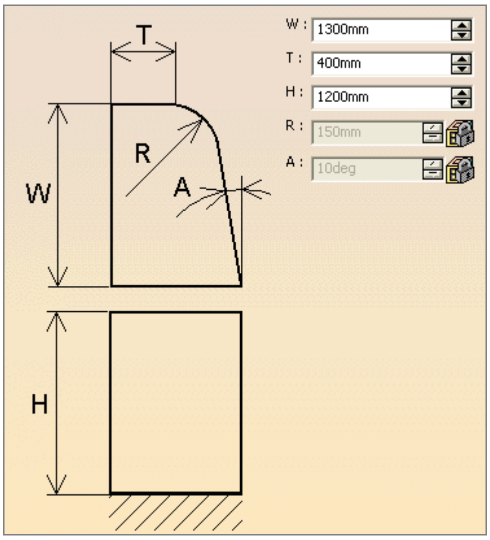
⑦ Shape Description

Description of the crash barrier in use. The list contains all defined barrier types that can be used by the application. (In standard mode the list is restricted to the barriers given by the standard.)

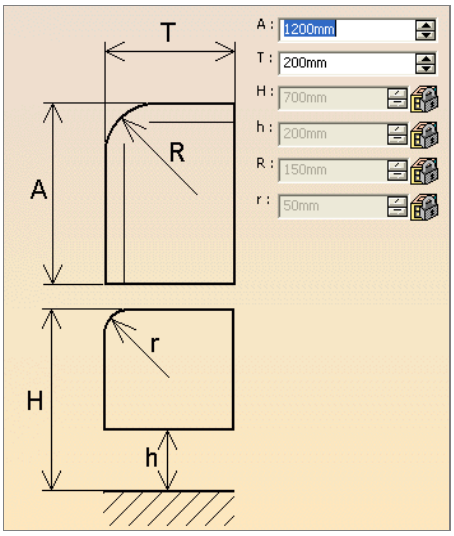
⑧ Shape Details

Show the measurement of the barrier in a separate window. The user can edit all fields that are not deactivated to define a different height or width of the barrier.

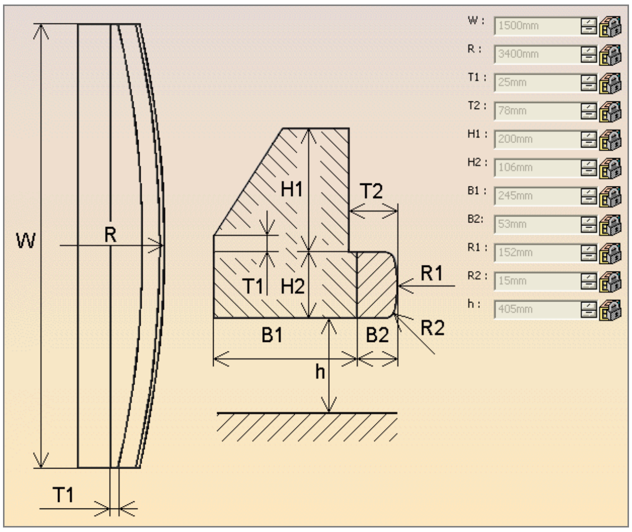
RCAR (2004) Front



RCAR (2004) Rear



RCAR (2006)



⑨ Reference Part

At the moment all barriers are defined by parameters. It is also feasible to use a reference part from which the geometry of the barrier is read out by the application (see point ⑥).

⑩ Position

Depending on the used standard the barriers can be positioned to front, back, left or right side.

- RCAR 2004: Front/Back
- RCAR 2006: Front/Back /Left/Right

⑪ Centric Position

The barrier is centered to the vehicle mid plane.

⑫ Overlapping

The percental overlap of the vehicle's geometry is directly in line with the edge of the adjustable barrier former or mobile barrier. The overlap is measured from the outmost geometry of the side specified in ⑬.

⑬ Side

According to the selected standard you can define if the barrier should be positioned on the left or right side of the vehicle (in driving direction).

This option is deactivated for standards that are using centric barriers.

⑭ Rotation

Defines a rotation of the barrier around the z axis.

⑮ Position to Geometry

If this option is active, the crash barriers will be positioned to the geometry that is selected in the corresponding geometry selection list ⑱.

If the geometry selection list is empty and the option *Position To Geometry* is selected, the vehicle measurements are taken from the CAVA base data.

If this option is not selected, the vehicle measurements are taken from the CAVA base data.

⑯ Additional Shift

Here you can define an additional shift in x direction.

⑰ Precision Positioning

If the *Position To Geometry* option is selected, you can influence the precision of the positioning of the barriers by moving the slider from accurate to fast. This affects the complexity of tessellation for the geometry.

⑱ Geometry Selection Lists

In order to position the barriers to the vehicle geometry you have to put the vehicle geometry into the respective geometry selection lists. Use the tab cards to get the appropriate geometry selection list.

⑲ Text hint for Update

This message will be shown if you have selected the option to suppress automatic update for the CAVA feature „Crash Barriers“ in the CAVA Settings. (Tools/Options .... Defaults).

9. Wheel Covering

International standards for wheel covering define a specific area of the outer edge of the wheels, which must be covered by the geometry of the fender, i.e. the plane, on which the outer edge of the wheel lies, must cut be in a certain area intersected by the fender. This area is defined by angles relative to the perpendicular. The standard ADR 42 contains for offroad vehicles specific requirements to the rear wheels covering.

CAVA WHEEL COVERING provides two different calculation methods:

1. On outer wheel plane

The CAVA WHEEL COVERING function creates in the model the corresponding limit geometries (target areas or “fields”) and facilitates checking the current geometry on standard conformity. The CAVA function allows to apply the European norms (78/549/EWG) and Australian norms (ADR42) as well as other norms using the same parameters.

The norms differentiate between general requirements that relate to non-off-road vehicles and the front axle of off-road vehicles on the one hand, and special requirements that relate to the rear axle of off-road vehicles on the other hand.

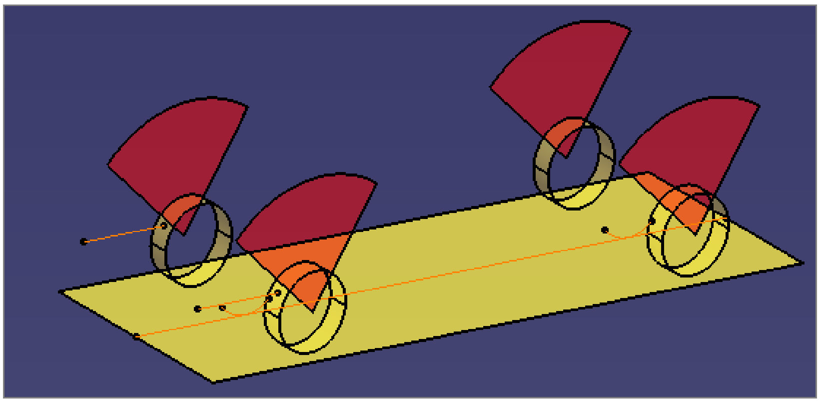
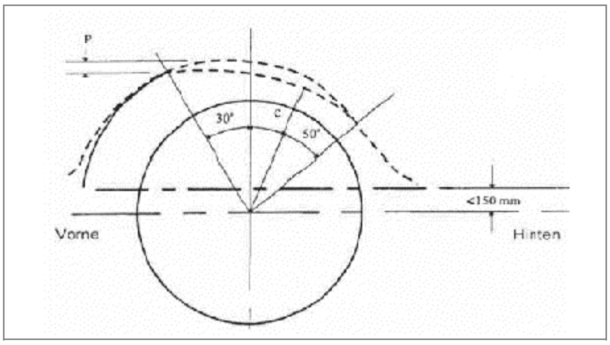


Fig.: Example for the CAVA representation of the wheel covering



General requirements: The indicated distance of 150 mm applies to the rear axle. It defines how far the wheel covering must reach towards the plane, running parallely to the road surface with a distance of 150 mm from the wheel centerpoint. For the distance between wheel center point and parallel plane, which is defined in the standard to be 150 mm, in the configuration files, if necessary, an other value can be set. The indicated distance *p* is not considered/calculated by the CAVA WHEEL COVERING function.

The angle area may be represented either by lines or by surface geometry at the outer edges of the wheels. The 150 mm distance is shown parallely to the road surface.

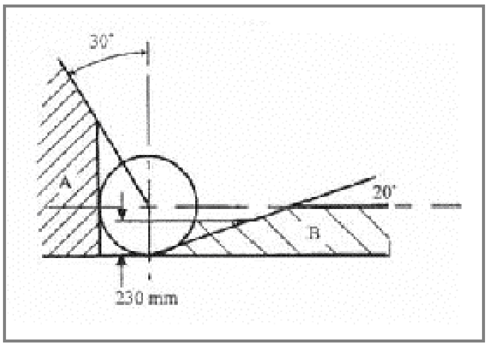


Fig.: Wheel covering for rear wheel of off-road vehicle

Special requirements to the rear wheel of off-road vehicles (according to ADR 42/30): The area A (in front of the rear wheel) is defined by the angle (in fig. 30 deg) and by the nominal diameter of the wheel. Area B is defined by height A (230 mm) and by an angle (20 deg). The wheel covering must thus cover the wheel in an area, corresponding to the non-hatched area above the areas A and B. The visualization for this is carried out by surface geometry, showing the area between A and B. Checking whether the whole wheel width is covered is the users responsibility, it is not executed by this CAVA function.

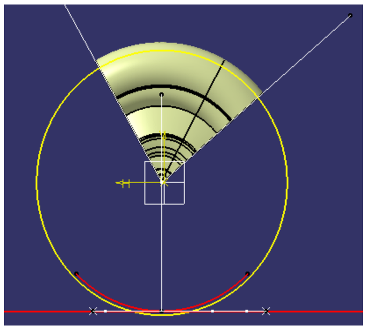
2. Pependicular to road

Different to the European or Australian standard, the Japanese do the test with car geometry perpendicular to the road. Taken into account that usually the wheels have a small wheel camber value, this is harder to fulfil.

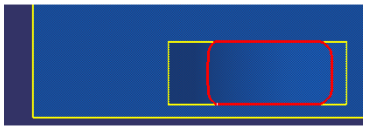
The calculation is done according to the following procedure:

- Step 1: The selected wheel geometry for the front and/or rear wheel is "cut" internally for each wheel by the 2 given angles so we get a "piece of cake" of the wheel. This split is in the whole *y* extension of the wheel. The cut is done perpendicular to the road in *y* direction.

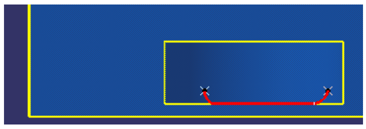
  (See fig. to the right–side view)



- Step 2: The split geometry is projected perpendicular onto the road. As result we get the contour of the split part. — (See fig. to the right–top view)

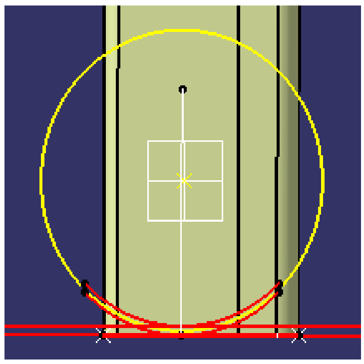


- Step 3: Now get the outermost part of the contour on the road. The limitation in *y* direction is given by the min/max values in *x* direction (in road system). — (See fig. to the right–top view)



- Step 4: Build an Extrude surface of this outer part of the contour in direction perpendicular to road.

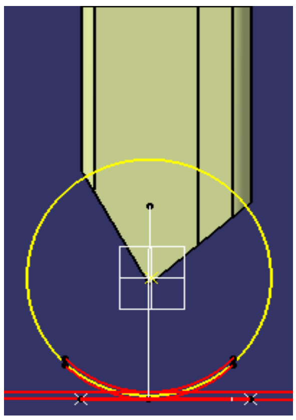
  (See fig. to the right–side view)



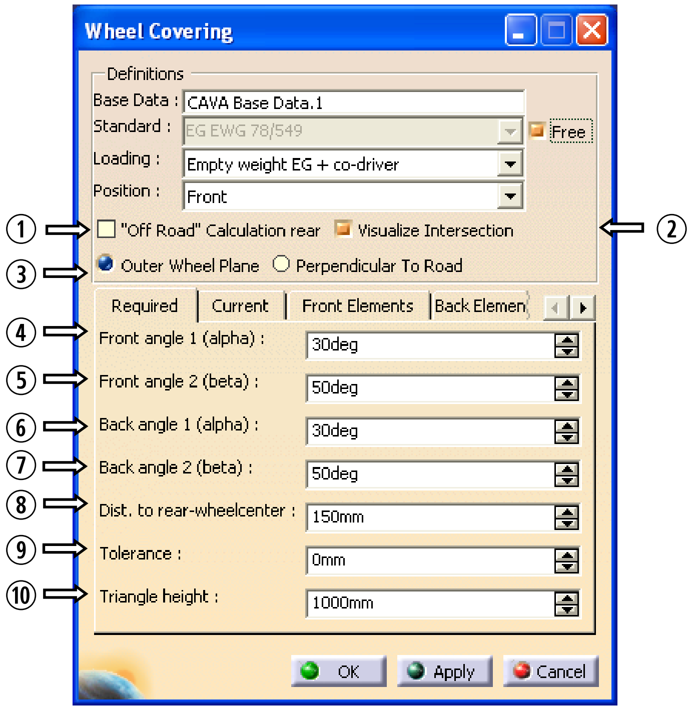
- Step 5: Cut the extrude surface in the side view by the given angles to get required surface.

  Start value is the height of the wheel center, the upper limit is defined by the given and already existing triangle height parameter.

  (See fig. to the right–side view)



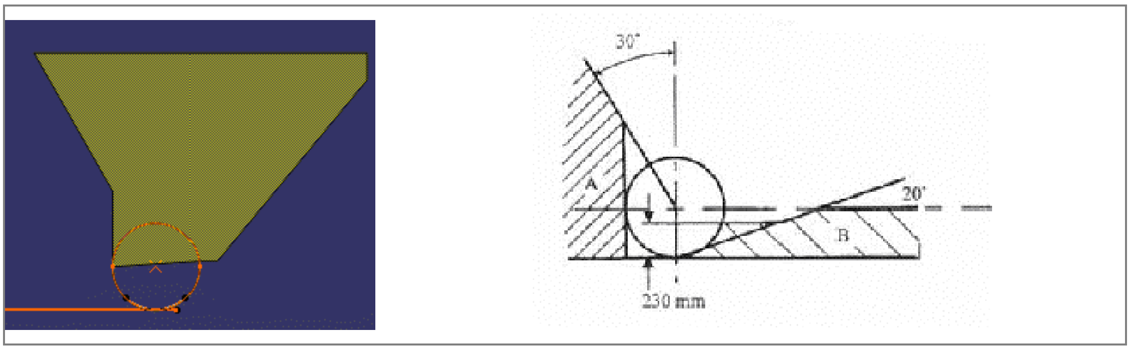
- ## Specifications in the GUI



① Off-Road calculation rear

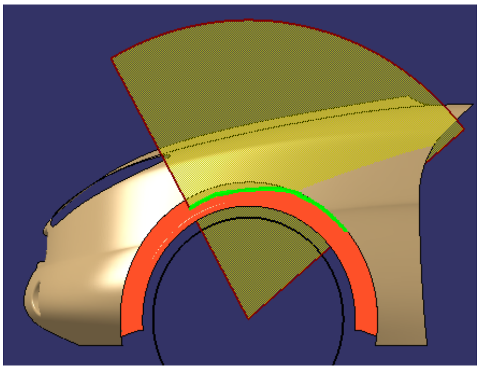
The standard ADR 42/30 imposes special requirements for the rear wheel covering of off-road vehicles.

When this option is activated, it will be checked whether the rear wheel covering in the non-hatched area above the areas A and B is continuous (see fig.).



② Visualize Intersection

This option visualizes the intersection of the vehicle geometry and the circle segment that is defined by the standard.



Example:

Green colored line is the intersection between the selected vehicle geometry (red colored fender element) and the circle segment geometry created by CAVA according to the standard definition.

The visualization of the intersection is only visible as long as the wheel covering dialog box is open.

③ Calculation Type

• Outer Wheel Plane
This calculation method uses a specific area on the outer edge of the wheels.

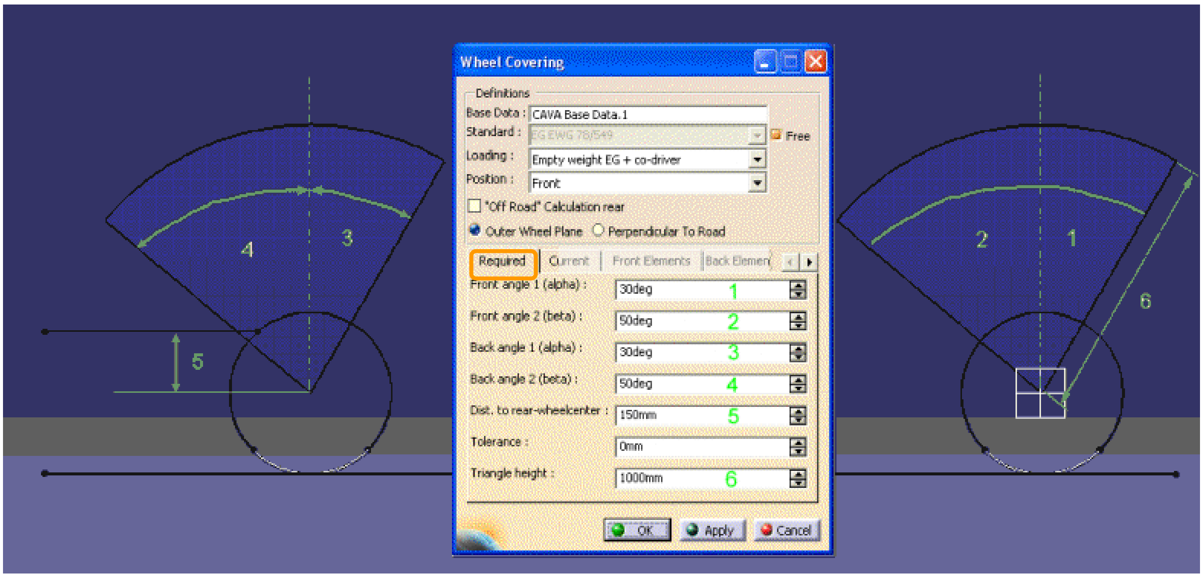
(see description below)

• Perpendicular to Raod
If you use this calculation method you will have to select additional wheel geometry (or use the basic CAVA wheel representation created from the base data feature).

If the wheel geometry is only selected for one side (left / right) the required surface is created as symmetry on the other side. If the wheel geometry is not selected the standard CAVA wheel is used for calculation.

(For detailed explanation see description below.)

④-⑨ Required values for the wheel covering



④ Front angle 1 (α)

Angle α for the front-wheel covering

⑤ Front angle 2 (β)

Angle β for the front-wheel covering

⑥ Back angle 1 (α)

Angle α for the rear-wheel covering

⑦ Back angle 2 (β)

Angle β for the rear-wheel covering

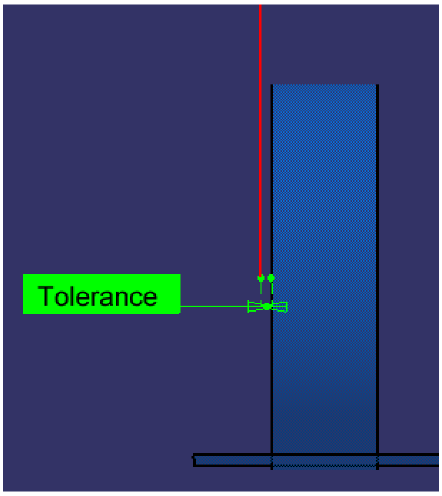
⑧ Distance to wheelcenter rear

The distance is valid for the rear axis and defines the area, up to where the wheel covering must reach, relative to the wheel center (see fig.).

⑨ Tolerance

If the production tolerances are worth, the user can define an additional "security tolerance" to be on the safe side, even if this is not required by the standard.

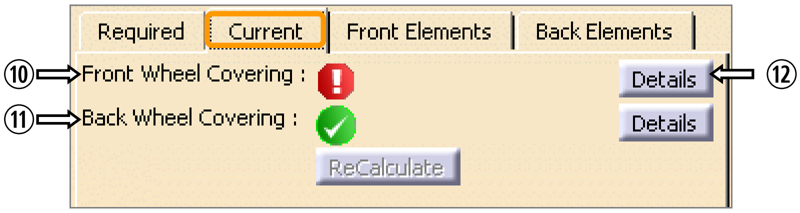
If the defined value is bigger than 0.0, the triangle surface that is representing the required wheel covering area is build for each wheel with the given translation. The translation of the required surface is in the outer direction of the wheel. The measurement OK / Violated will be done with the translated surface.



⑩ Triangle Height

Length or respectively radius of the represented circular sector

This value must be specified in every case as it is not covered by the standards.



⑩-⑫ *Current* tab card

Measurement result output for Front/Back wheel Covering

It is calculated if the complete area, which is defined by the angles, is covered by geometrical features, i. e. if the angle area of the required surface is intersected completely by the existing geometry. If for the rear axle the additional line of distance to the wheel center is defined, this line also must be intersected by the existing wheel covering geometry.

⑩ Front wheel covering

Result for the front axle

⑪ Back wheel covering

Result for the rear axle

⑫ Button Details

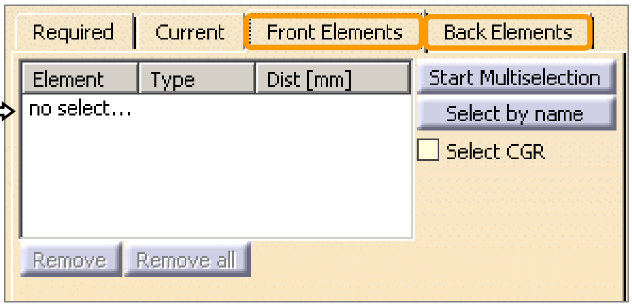
This button opens a dialog box with additional information concerning the measurement result. E. g. in case of a violation of the standard for the rear wheel covering the user obtains a message, whether this was caused by the selected geometry or by the back line criterion

Possible messages:

- "The standard is satisfied."
- "The standard is not satisfied."
- "The standard is not satisfied. The extra line at rear wheel is not covered."

It is possible to select the geometry only for one of the sides. The measurement then will be executed only for this side.
If you select the vehicle geometry just for one side (right or left), it must not exceed the vehicle mid plane. Otherwise the surfaces will also be taken for the check of the other side.

⑬

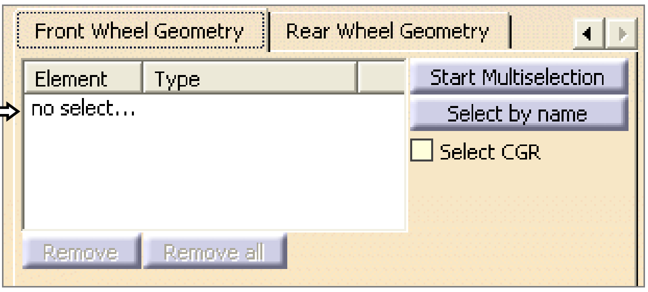


Front Elements / Back Elements tab cards

On these tab cards the features can be selected, which are to be used for checking the wheel covering. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

⑬ Select by mouse clicking in the model (on the CATIA workspace or in the specification tree) one or several features to check the wheel covering. The tab cards have an identical functionality. (For detailed proceeding see CAVA User Manual—General, section “CAVA Measurements”.)

The selected surfaces must have some extension in y-direction; otherwise they might not be detected.

⑭ 

Front Wheel Geometry / Rear Wheel Geometry

These tab cards are only active if the calculation method "*Perpendicular to Road*" has been selected. Here you can select all geometry elements of the wheels, which should be used to create the required surfaces for the covering calculation as described below (Method 2—Perpendicular to Road)

⑭ Select one or several geometry elements that represent the vehicles wheel by by clicking in the CATIA model or specification tree.

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

10. Seat Belts

Die The CAVA *Seat Belt* function allows to generate in the part, according to the vehicle data, the required fields where the belt mounting points must be situated. The position of the fields depends mainly on which seat adjustments are envisaged. The seat adjustments in the model can be predefined, using curves (see fig. below under the *Seat Definition* check boxes ③-⑤).

The belt fields are displayed as planar surfaces at the specified positions. The different seat adjustments (longitudinal, height, angular) can be defined on the GUI additively. For each of the adjustments, the user has to select the corresponding curve. These curves must lie in the plane that runs parallely to the vehicle midplane through the seat reference point (SRP).

For the belt mounting points (i.e. for buckle and end fitting) it must also be defined whether the respective point moves accordingly to the seat adjustment curves or whether it is fixed to the car body.

On the base of the user specifications, the CAVA *Seating Belts* function calculates the respective fields. The US and Canadian standards do not specify requirements for the angular seat adjustment. CAVA however allows—beyond the standard requirements—to specify these values.

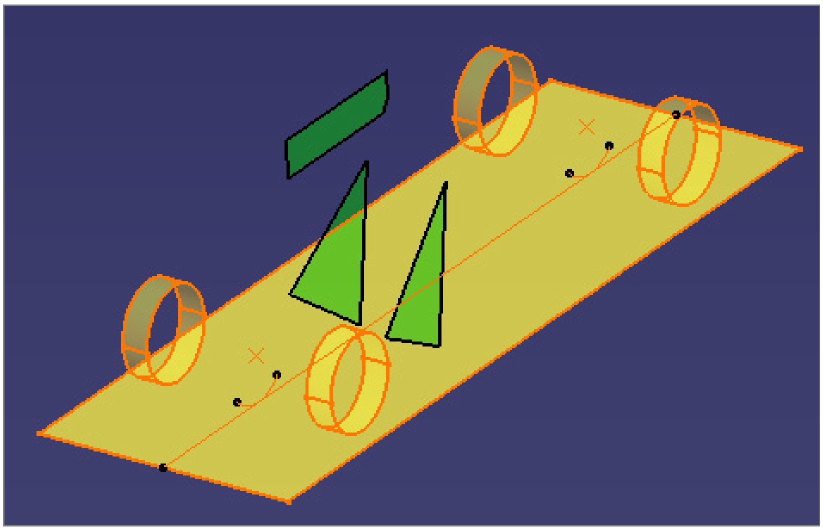
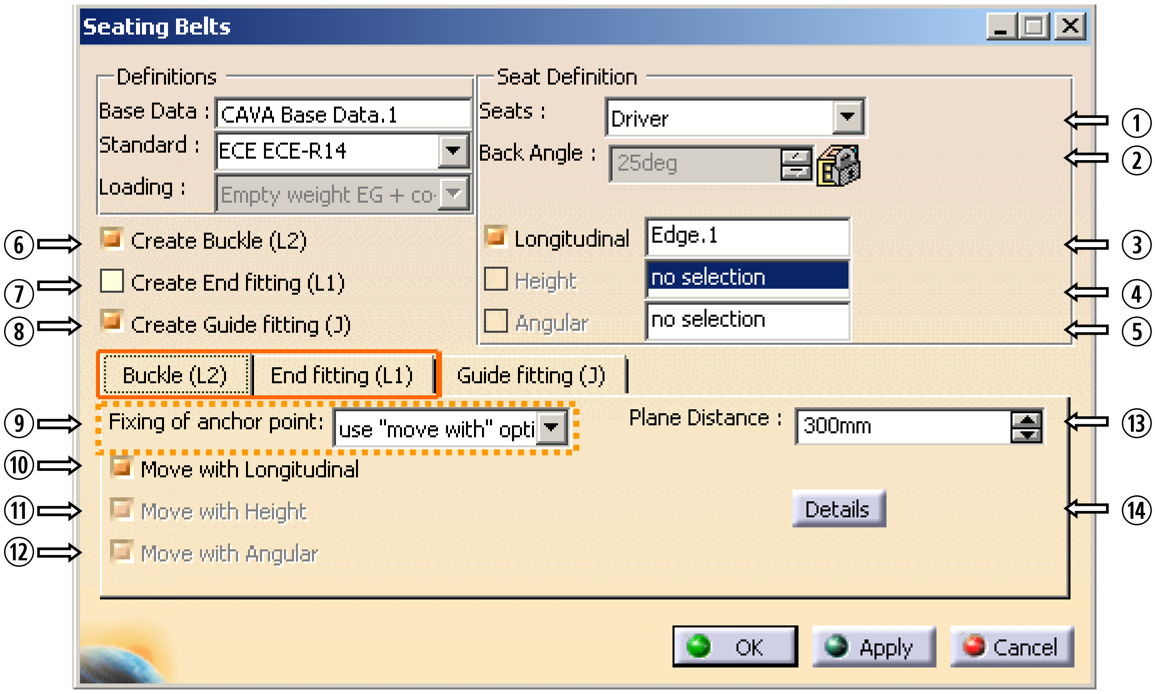


Fig.: Example for the representation of the belt-anchor fields in CAVA (in green color). The pictures show the fields for buckle, end fitting and guide fitting of the drivers' seat.

- Specifications in the GUI



For the CAVA *Seating Belts* function the *Free* mode is not available.

① *Seats* list box

Select a seat for which the belt-anchor fields are to be calculated. The list box contains all seats that have been defined and activated in the base-data dialog box on the *Seats* tab card.

For every seat, an individual belt-anchor point feature must be created, which is independent from the other belt-anchor point features. To do so, close the dialog box of the already created belt-anchor point feature and create then a new feature.
For every CAVA belt-anchor point feature, in the specification tree the name of the referenced seat is displayed.

The precondition to be able to select a seat is that the seat reference point (SRP) must be defined (in the base-data dialog box on the *Passengers* tab card). Otherwise the belt points will be created relative to the origin.

② *Back Angle* spinner box

This list box displays as information the back angle of the seat to be calculated is displayed for information.

Whether the back angle spinner box is editable or not depends on the settings in the configuration file.

(3-5) Check boxes for the seat definition

- *Longitudinal* check box
(controls seat adjustment in longitudinal direction)

- *Heigth* check box
(controls seat adjustment in vertical direction)

- *Angular* check box
(controls seat inclination)

- To allow an anchor point to follow one of the seat adjustments directions, proceed as follows:

(1) Activate the respective option by clicking in the list box (3-5).

(2) Select the respective displacement path by clicking on the respective curve in the model.

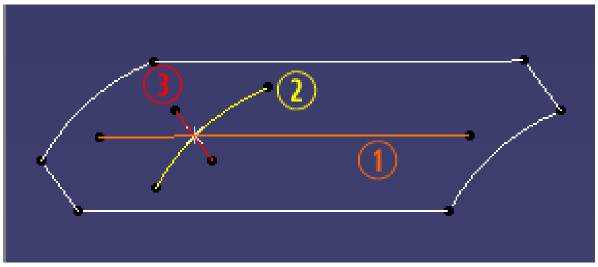
As soon as one of the options (3-5) is activated, on the *Buckle* or *End fitting* tab card the respective check box (10-12) is also activated.

Fig.: Seat displacement curves

1—longitudinal seat displacement curve

2—vertical seat displacement curve

3—seat inclination displacement curve

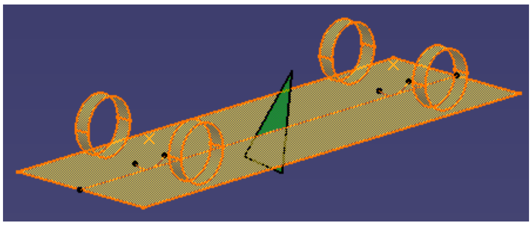


The selected curves must lie in the plane that runs parallely to the vehicle midplane through the seat reference point (SRP).

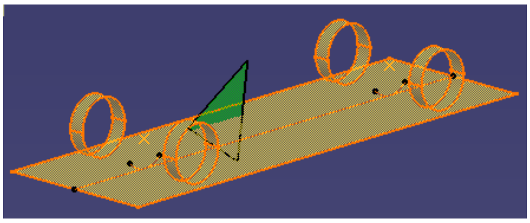
(6-8) Check boxes for belt-anchor selection

The check boxes (6-8) can be activated independently from each other, according to the users' requirements. As soon as an option is activated, in the CATIA workspace the field for the respective belt-anchor is displayed (see fig. below).

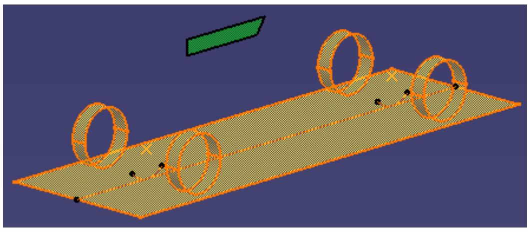
⑥ *Create Buckle* check box



⑦ *Create End Fitting* box



⑧ *Create Guide Fitting* check box



Buckle L2 and *End Fitting L1* tab cards

⑨ *Fixing of anchor point* list box

This list box is displayed only if in the *Standard* list box the US standard is selected.

The list box contains the following options for the movability of the belt anchors:

- Fix with car body: All check boxes ⑩-⑫ are deactivated and locked for the user.
- Integrated in seat: All check boxes ⑩-⑫ are activated, but remain locked for the user.
- Use „move with" option: All check boxes ⑩-⑫ are activated and unlocked for the user.

⑩-⑫ Check boxes for the movability of the belt fittings

To activate these check boxes, activate first the options ③-⑤ (for details see there).

- In case of ECE standard:

The check boxes can be activated independently from each other, according to the users' requirements. Activating a check box activates the respective displacement path for the respective fitting, i.e. the respective fitting then can be moved together with the seat.

- In case of US standard:
  The access to the check boxes additionally depends from the selected item in the *Fixing of anchor point* list box ⑨ (see there).

⑩ Move with longitudinal: Fitting moves with seat in case of longitudinal displacement

⑪ Move with heigth: Fitting moves with seat in case of height adjustment

⑫ Move with angular: Fitting moves with seat in case of inclination adjustment

☞ The settings for movability of the anchors have a significant influence on the position of the belt-anchor fields.

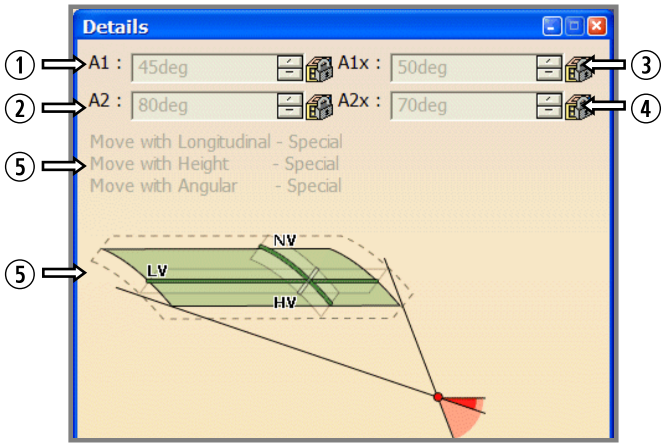
⑬ *Plane Distance* spinner

Distance of the belt-anchor field from seat reference point (SRP) in *y* direction

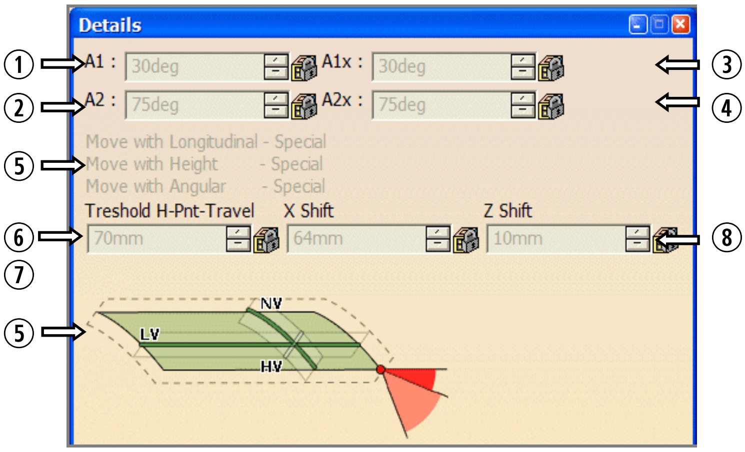
⑭ *Details* Button

This button opens the dialog box below, which gives detailed information about the values used for calculation.

Example: *Details* Dialog Box for European Standards



Example: *Details* Dialog Box for American Standards



① ② *A1* and *A2* spinner boxes

Lower/upper limiting angle of the belt anchor field (its vertex is situated on the parallel to the road surface which runs through the SRP or the H point).

③ *A1x* spinner box

Angle used in certain cases instead of A1.

④ *A2x* spinner box

Angle used in certain cases instead of A2.

Which of the angles (A1 or A1x and A2 or A2x) is used depends from the settings in the configuration file.

The European standards specify, in comparison to the American standards, other angle values for the case that belt anchors (buckle and/or end fittings) move with all seat-displacement paths (or some of them). Which of the displacement paths are taken in consideration is defined in the configuration file. The *Special* flag, appended as suffix to the designation of the displacement path, signals that for the A1 and A2 angles different values are used. In the configuration file different values can be defined for front and back seats.

In the American standards there is no such differentiation of the angles; the values of A1 and A2 are identical. In general, the angle adjustment (seat inclination) here is not regarded.

⑤ Possible displacements

5.1 Text: In black the displacements are displayed that will taken in consideration when calculating the belt-anchor field; paths that are not taken in consideration are grayed.

5.2 Figure: The figure shows the selected standard and the settings. In dark green the displacements are displayed that will taken in consideration when calculating the belt-anchor field.

⑥ *Only for American standards*

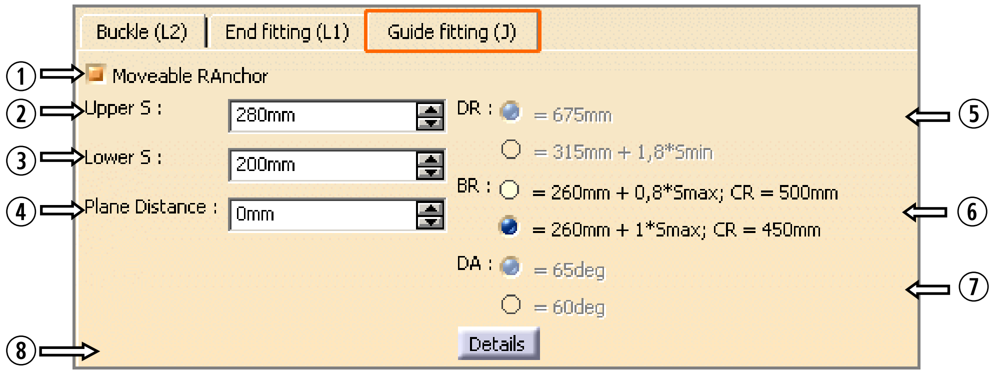
Threshold H-Pnt-Travel spinner:

The American standards contain a limit for the longitudinal displacement, for which the *x*-extension of the selected curve is regarded.In this spinner box, the limit value for the longitudinal displacement is shown. For the case that this limit value is exceeded, for the position of the belt-anchor field a shift is defined for the peak of the field (see below ⑦ ⑧).

⑦ ⑧ *Only for American standards*

X-Shift and *Z-Shift* spinner boxes

Here the values are shown for shifting the peak of the belt-anchor field from the hindmost point of the seat adjustment field with regard to the possible displacements.



Guide Fitting tab card

① *Moveable RAnchor* check box

This check box controls whether the guide fitting must be height adjustable or not. In case of height adjustable the *Upper S* spinner box is activated.

②③ *Upper S* and *Lower S* spinner boxes

Mesure „S"—distance of the guide fitting in *y* direction from the seat midplane for the upper/lower point (in case of height adjustment) If there is no height adjustment, the *Lower S* mesure defines the fixed distance to the seat midplane.

④ *Plane Distance* spinner box

Distance of the belt-anchor field from seat reference point (SRP) in *y* direction

⑤ *DR* radio button *(displayed only for European standards)*

If the minimum value of the measure "S" (normally "upper S", under certain geometrical circumstances "lower S") is less/greater than 201 mm, CAVA switches the definition for the measure "DR":

- `S = 201` → `DR = 675`
  (The exact definition is: but usually `ShMulti2b = 0`, what results in not displaying `ShMulti2b` on the GUI.)
- `S < 201` → $DR = 315 + 1{,}8*S_{min}$

⑥ *BR* radio button *(displayed only for European standards)*

If the maximum value of the measure "S" (normally "lower S", under certain geometrical circumstances "upper S") is 280 mm or greater and if the *Moveable RAnchor* check box ① is activated, the user can select how to define the measure "BR":

- `S < 280` → only Option $BR = 260 + 1*S_{max}$; `CR 450` is possible.
- `S = 280` → It is possible to select between the options.

⑦ *DA* radio button *(displayed only for European standards)*

The predefined value for the DA angle is displayed; this radio button is deactivated for the user.

⑧ *Details* Button

If this button is pressed, a dialog box will be opened with an overview of all values of the guide fitting.

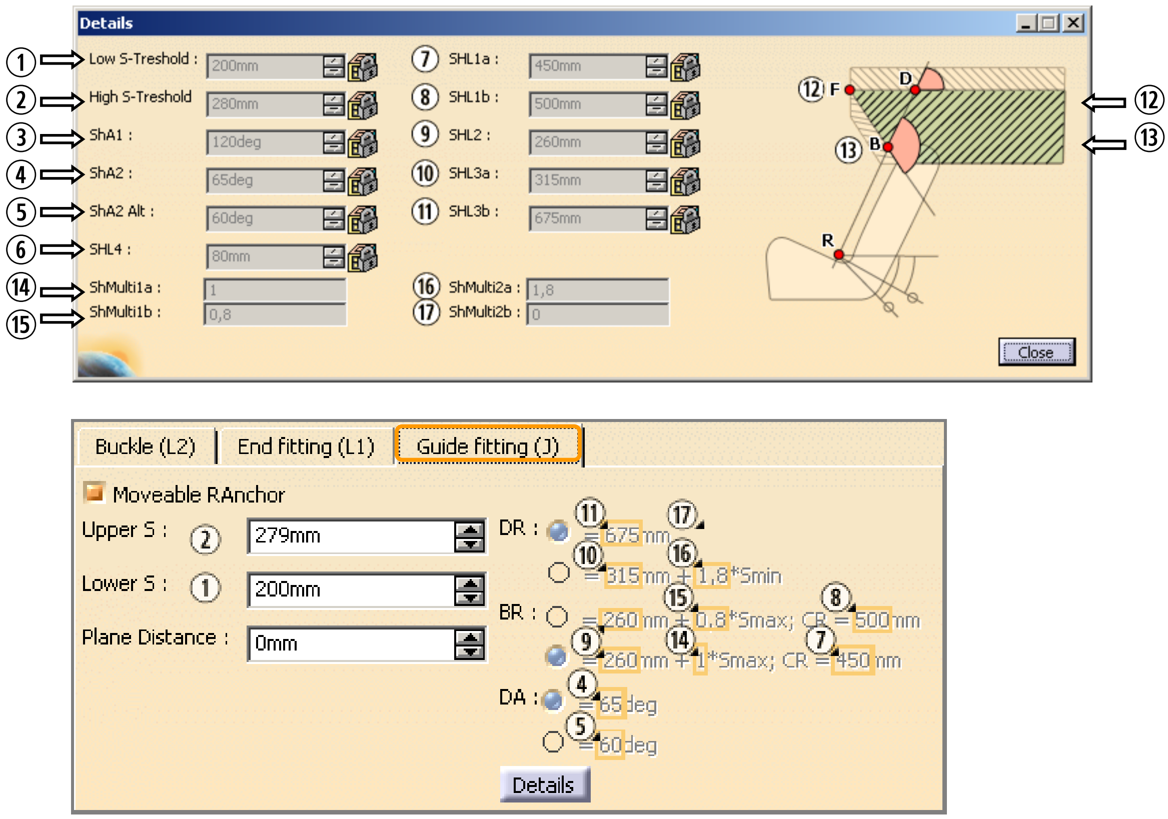


Fig.: Correlation of the values of the height adjustable guide fitting from the *Details* dialog box

Details dialog box

In this dialog box gives for information an overview of all values of the guide fitting.

It is not possible here to adjust values. The displayed values are taken from the configure-tion file and from the *Seating Belts* dialog box. The figure illustrates which values from the *Seating Belts* dialog box correspond to which values of the *Details* dialog box.

⑫ The aspect of the figure on the right side of the dialog box depends from which standard has been selected and which settings have been made (for instance, from activating or not the *Moveable RAnchor* check box on the *Guide fitting* tab card of the *Seating Belts* dialog box). If the *Moveable RAnchor* check box is activated, the additional areas will be displayed in green, and a double arrow at point F indicates that the field is enlarged.

⑬ `B` Angle in B

⑭ `ShMulti1a`
⑮ `ShMulti1b`
⑯ `ShMulti2a`
⑰ `ShMulti2b`

Multiplier that are taken from the configuration file

For description of the standard buttons see page 8; for general specifications in CAVA OVA see page 36 ff.

11. Child Protection System

For the fixing of child restraint systems, CAVA offers two functions One of them defines the fields in which the fixation of the „top tether“ (i.e. the belt used to fix the child seat) has to be situated. the second one defines the shape of the clearance volume required to the fixing. This second function is described in chapter 12 *Free Space Top Tether* on page 114.

Die CAVA CHILD PROTECTION SYSTEM function supports the north american standard FMVSS 225 (CMVSS210.1) and the Australian standard ADR 34.

The fields for the child restraint system (i.e. the space within which the child restraint system can be fixes) are shown as volumes. The shape of the volume for the Australian standard (disk with parallel lateral faces) is different from that for the American standard—see fig. below.

For the sphere that is cut out from the volume (in difference to the exact American standard) the Australian standard does not use the „wrap-around length“, but a sphere with corresponding radius.

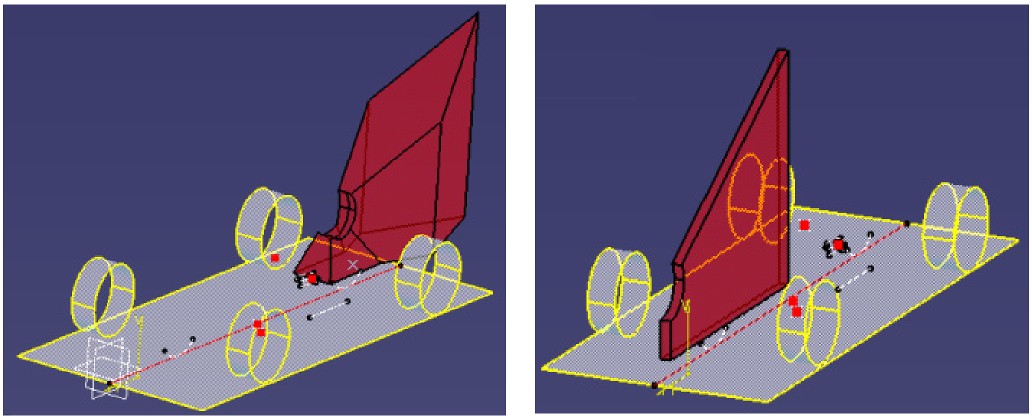
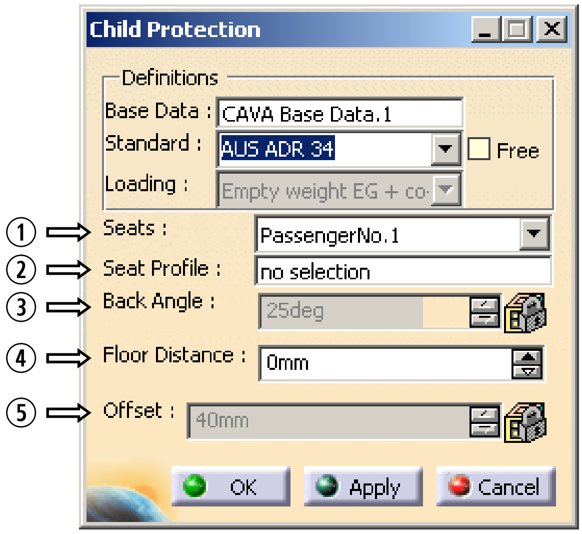


Fig.: Example for the representation of the child protection system in CAVA (in red color)—on the left according to US standard, on the right according to the Australian standard.

- **Specifications in the GUI**



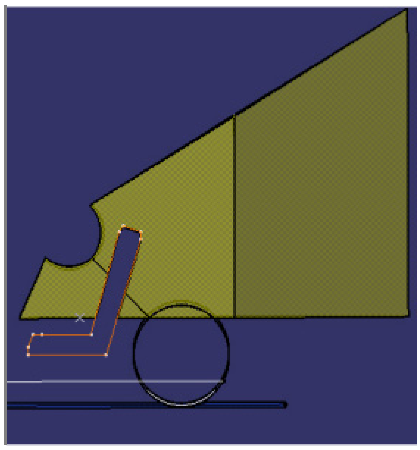
① *Seats* list box

Select from the list a seat, for which the child protection system is to be calculated and displayed.

- Precondition for seat selection in the list box: The seats must have been defined and activated in the base-data dialog box on the *Seats* tab card.
- For the driver's seat no child protection system can be defined.
- For every additional child protection system a new component must be created.
- For every CAVA child-protection feature in the specification tree the name of the referenced seat is displayed.

② *Seat Profile* reference box

In this box, a seat profile may be referenced that shows the required seat in side view. The profile must be a closed curve.
Referencing will result in cutting out from the top-tether volume the area of the seat that protrudes into the volume.



③ *Back Angle* spinner box

Here the current value of the back angle from the base-data feature is displayed (can not be changed here).

④ *Floor Distance* spinner box

Here (if necessary) a value for the distance from SRP to floor may be specified (what will change the extension of the surface in negative z direction).

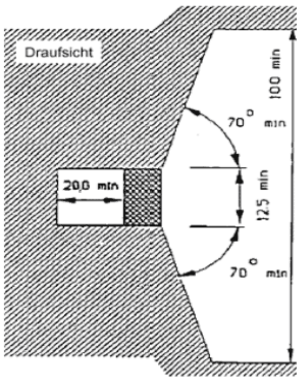
⑤ *Offset* spinner—only for Australian standard

This spinner controls the distance between the lateral surfaces (i. e. the width) of the top-tether volume. (The position of the midplan of the volume remains always unchanged.)

12. Free Space Top Tether

This function creates the limit geometry of the grip clearance that must be provided to be enable the vehicle user to fix the child-seat top tether according to the Australian standard ADR 34. The grip clearance is required for the hand when fixing the top tether. The limit geometry is visualized as volume.

CAVA does not regard the case, which is also described in the ADR 34 standard, that only an end fitting exists.



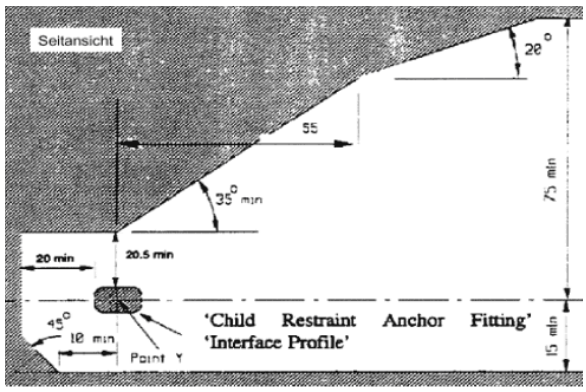


Fig.: Grip clearance—top view

Fig.: Grip clearance—side view

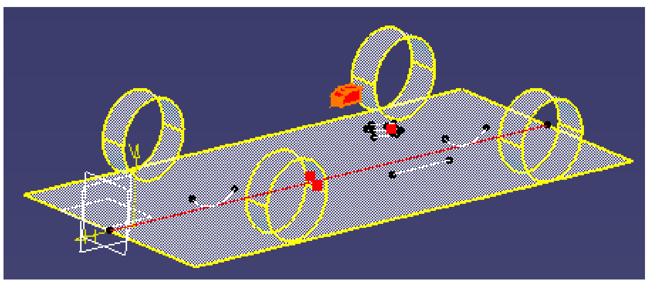
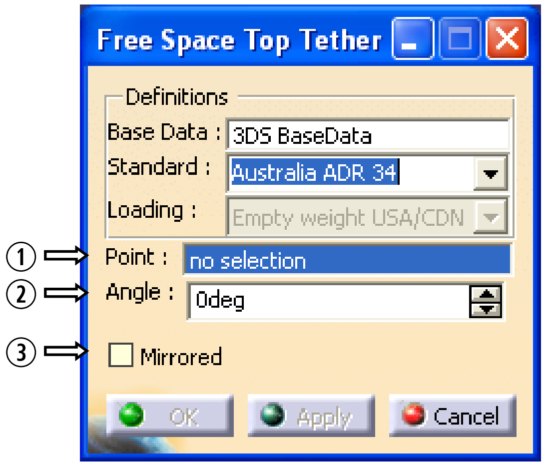


Fig.: Visualization of the grip clearance on CATIA workspace

- **Specifications in the GUI**



① Point

Reference point (V5 point), at which the grip clearance is to be positioned.

② Angle

Angle of rotation of the grip-clearance volume around *y* axis

③ Mirrored check box

If this option is activated, the grip-clearance volume in the model will be represented mirror-inverted relative to the *y* axis (it will be represented only the mirror-inverted volume).

* * *