# CAVA - VISION

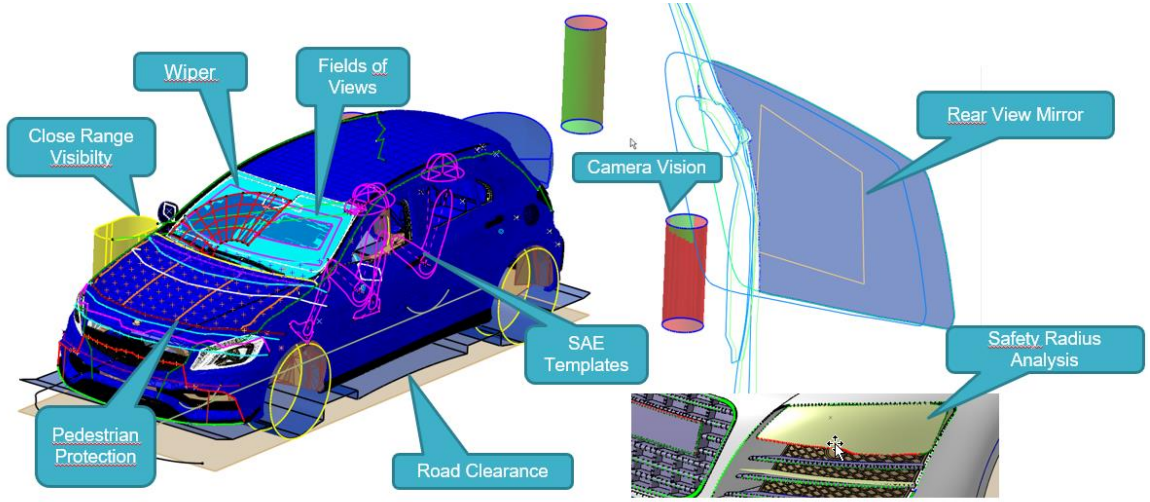
Functional Overview

2023-04-20

# CAVA – Vehicle Homologation

Vehicle Compliance is a compulsory part of Automotive design. CAVA (CATIA Automotive Extensions Vehicle Architecture) provides the solution to efficiently and confidently validate the compliance of your vehicle design and architecture against international standards and regulations.

Available as a CATIA V5 or 3DEXPERIENCE enhancement, CAVA is successfully used by OEMs and suppliers world-wide and can be installed as a complete solution or as individual sub products for specific application areas.




## CAVA Product Portfolio

- **CAVA OVA:** Verify the overall vehicle packaging
- **CAVA Manikin:** Verify seating positions, pedals and headroom
- **CAVA Vision:** Analyze the direct and indirect vision of the driver
- **CAVA Safety:** Analyze safety of occupants and pedestrians
- **CAVA Wiper:** Analyze wiper kinematic and wiping quality
- **CAVA Tools:** Project the silhouette outlines of a complete vehicle with one click using Silhouette Tools

# CAVA – General Features

## Integration into CATIA

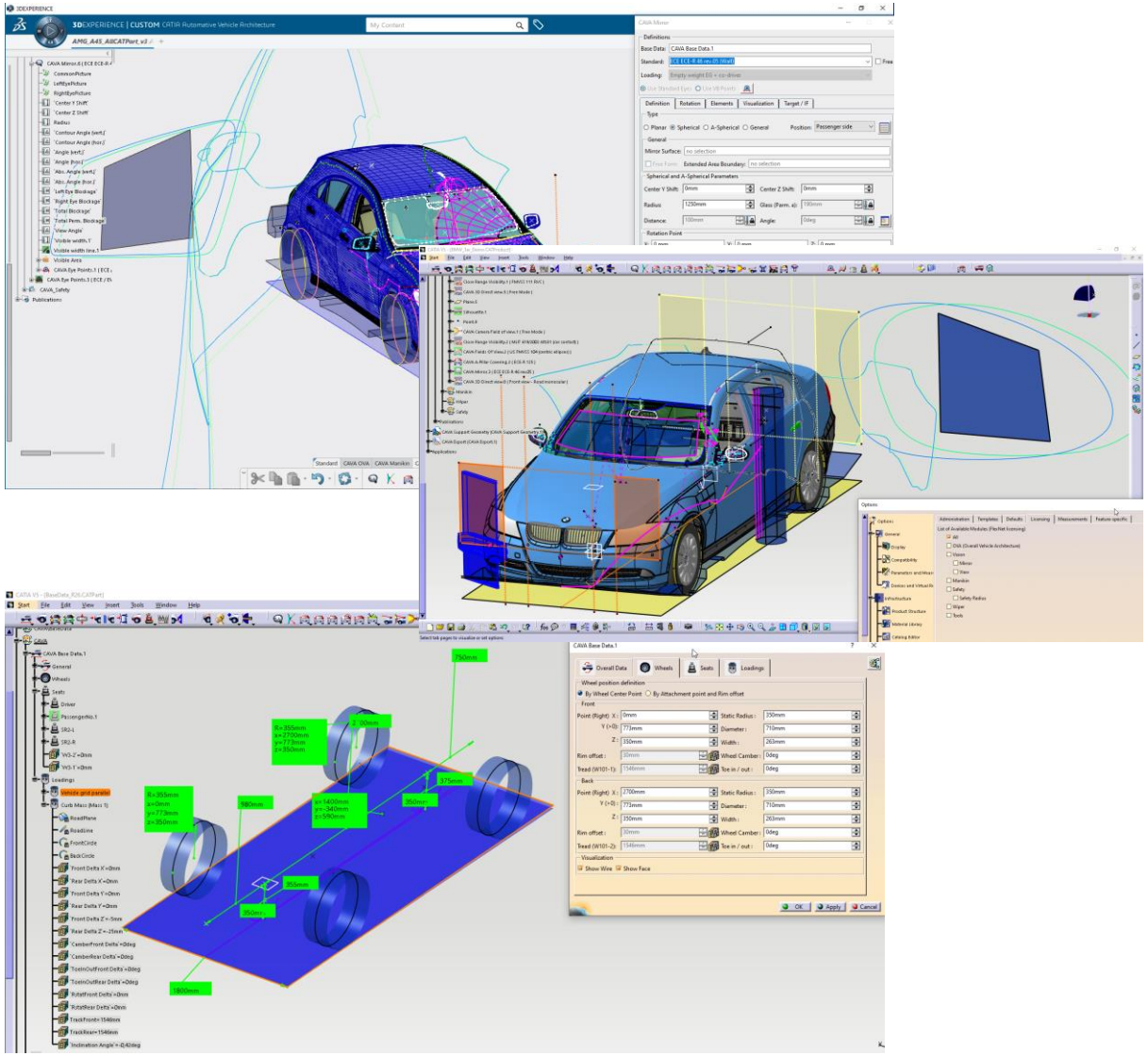
- CAVA is integrated into CATIA as a separate workbench or App.
- CAVA features are stored directly with the CAD data.
- Working in part and product context.
- Automatic feature update on change of any input parameters or changed geometry.

## Configurable and Open

- Supported Standards are available as readable xml file.
- You can create your own adapted company-specific standards easily.
- Export your results as regular CATIA Geometry for downstream applications, readable without CAVA.
- Create textual, excel and drawing reports using customizable report templates.

## Base Data Concept

- Organize relevant parameters in a central location.
- Define vehicle size, wheel size, driver and occupant placement.
- Define different ground reference planes to accommodate loading configurations.



# CAVA Vision – General

CAVA Vision functions automatically provide internally calculated eye points and eye ellipses for the driver, as required by the specific vision function.

## Supported standards

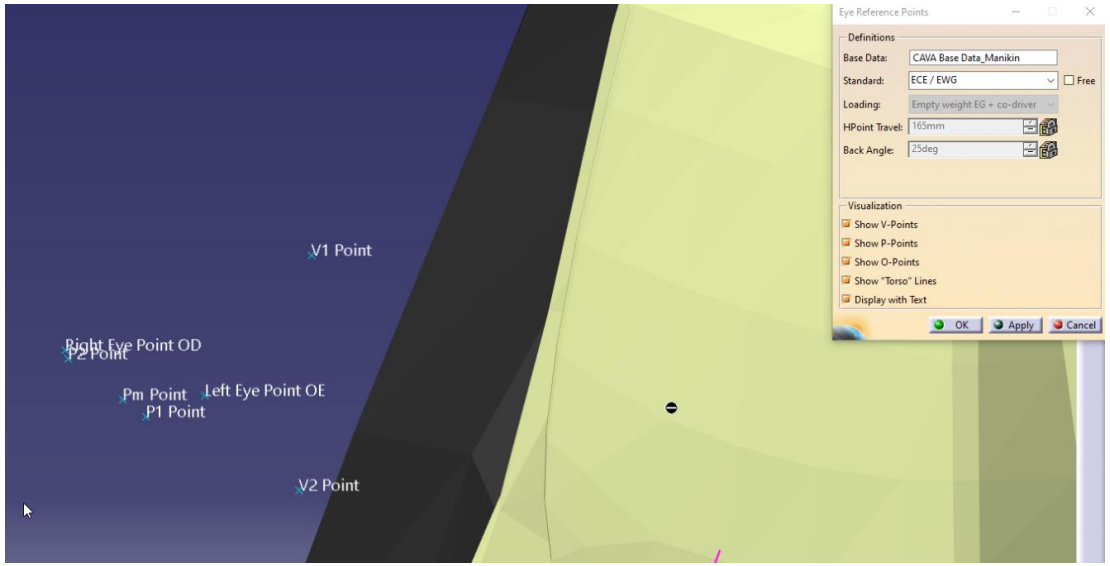
- Eye Points: ECE / EWG, ADR
- Eye Ellipses: FMVSS / SAE J941 (1965, 1997, 2002)

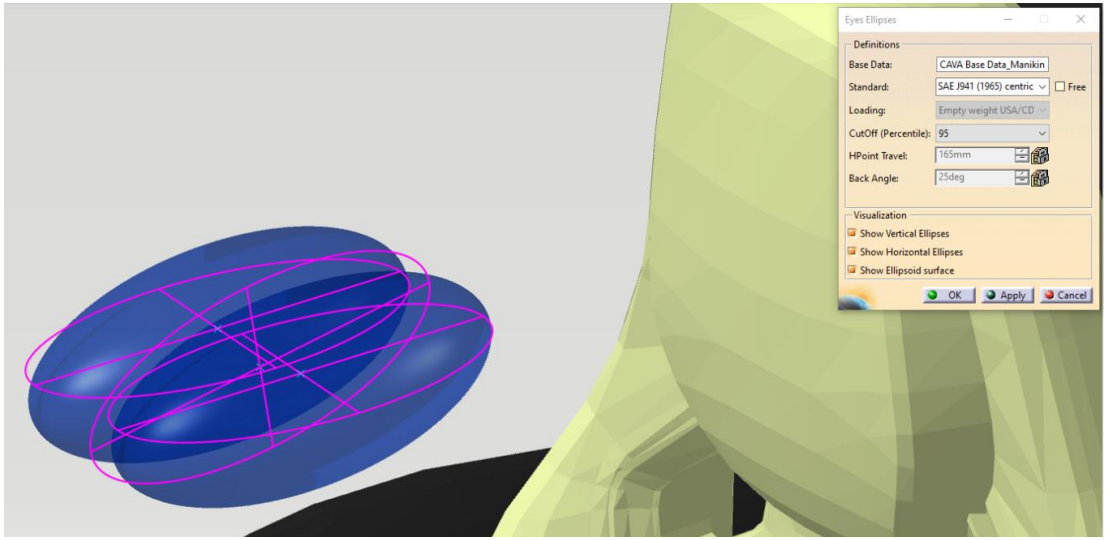
## Features

- ECE eyepoints (V-Points, O-Points, P-Points) according to UNECE-R 125 for different purposes in vision and mirror analysis.
- SAE 941 Eye Ellipses as required by FMVSS vision standards
- Considers SRP point, seat back angle, seat travel, percentile and other seating parameters

## Result

- Eye Points or Eye Ellipses are automatically created as part of the vision feature as required for the selected standard



# CAVA Vision - Fields of View on the Windshield

The fields of view on the windshield describe areas on the windshield, which are relevant for certain studies. These A-, B- and C-Fields are required to check the regulations for the wiped area, defrosting or optical properties of the windshield.

## Supported standards include

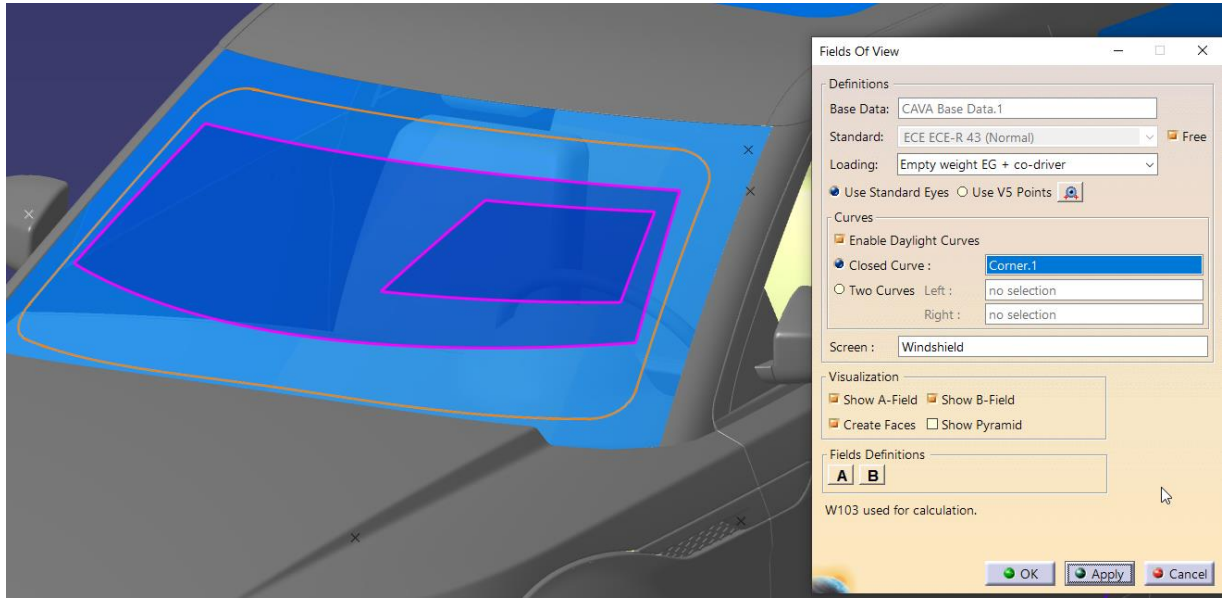
- ECE-R 43, EG EWG (Wiper, Defrosting)
- FMVSS 104, CMVSS 104
- ADR 16,  ADR 8, China GB 11555-2009 Defrosting

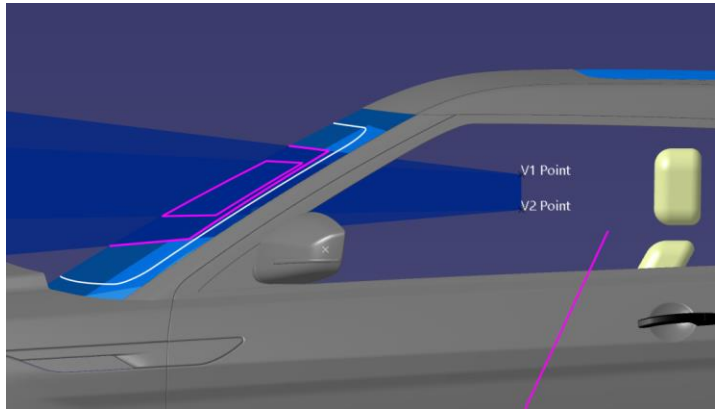
## Features

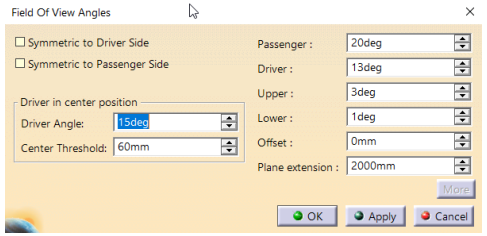
- Calculates the boundaries and surfaces for the A,B,C fields
- Automatically uses Eye Points or Eye Ellipses acc. to selected standards
- Option to consider daylight opening curves
- Optional visualization of the view pyramid planes

## Result

- Visualization of field boundaries and surface
- Feature ready to be use for CAVA wiper and CAVA optical properties analysis



# CAVA Vision – Extended/ Reduced Fields of View on the Windshield

The standard ECE-R 43 defines an extended A-Field and a reduced B-Field. Considering that vision reference points on the windshield always need to be in the visible area, several options are available how to define the reduced B-Field in practice.

## Supported standard

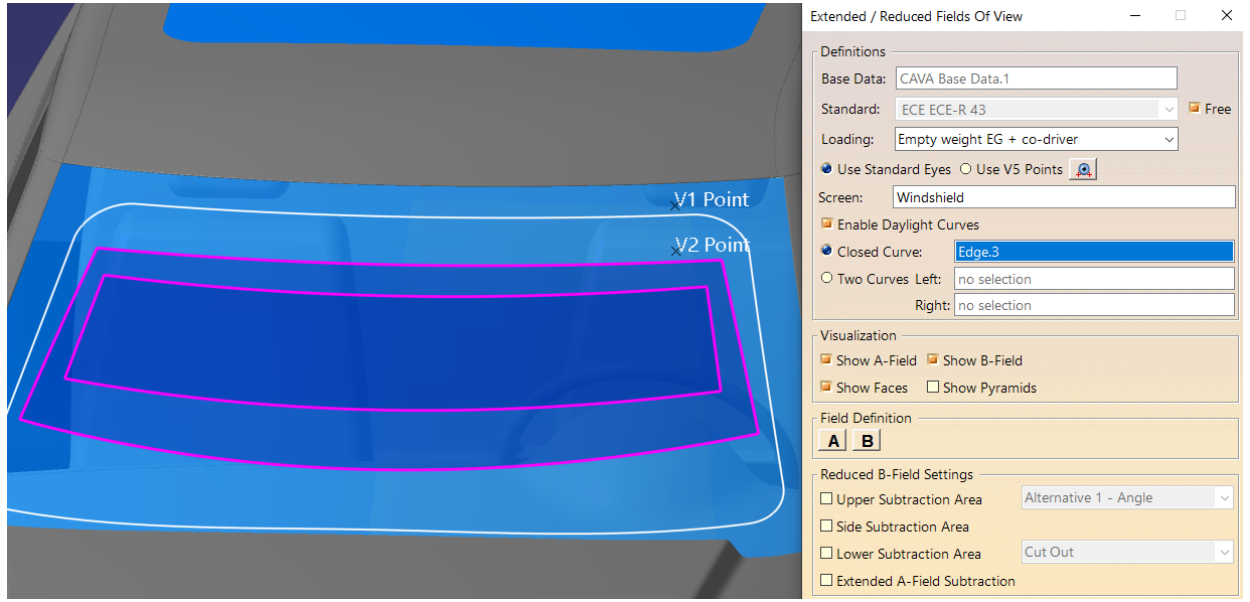
- ECE-R 43

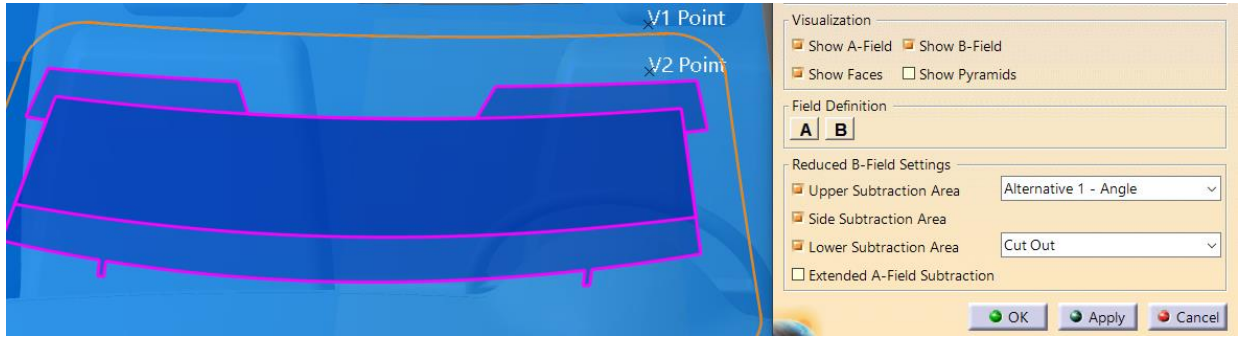
## Features

- Different options to create the lower, upper and side subtraction areas (cutouts)
- Automatically uses Eye Points for ECE  (V-Points)
- Optional visualization of the view pyramid planes including the subtraction areas

## Result

- Field boundaries and Field surfaces for extended A-Field and reduced B-Field



# CAVA Vision – A-Pillar Obstruction

This feature calculates where the field of view is obstructed by the A-pillars according to the UNECE-R 125 regulation.

## Supported standard

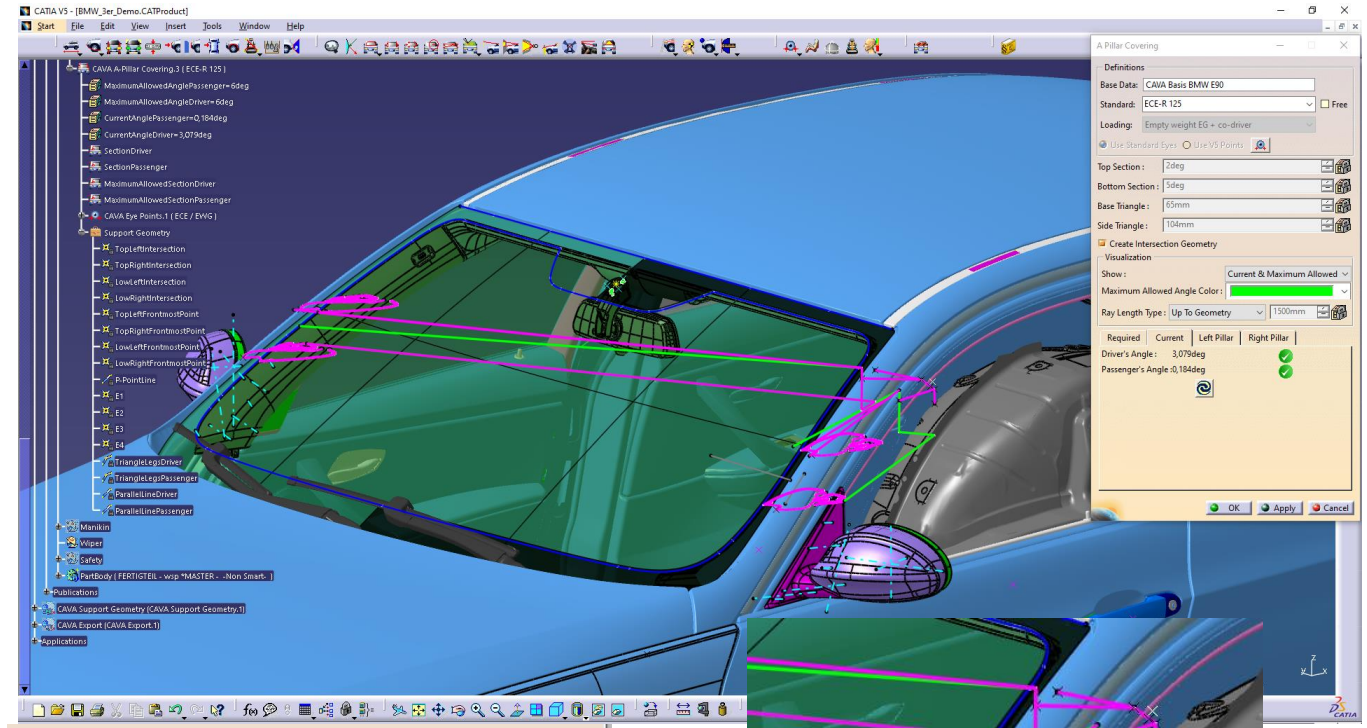
- ECE-R 125

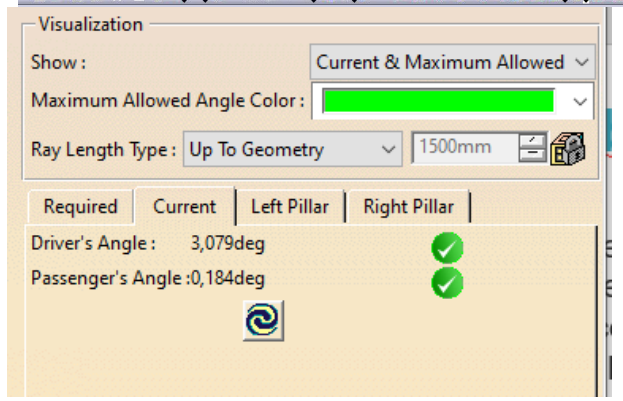
## Features

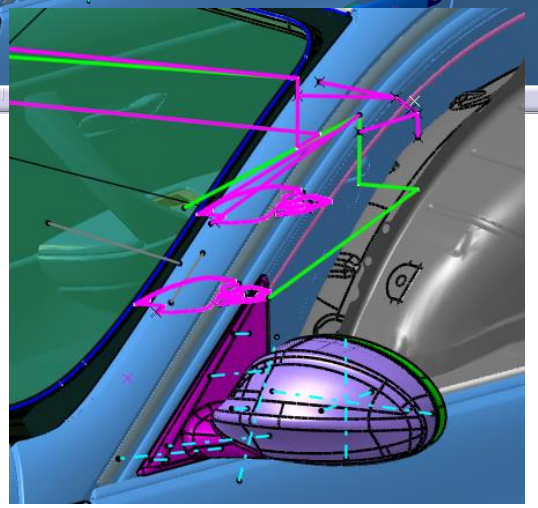
- Calculate the ambinocular obscuration angle of the A-Pillar geometry for left and right side
- Uses the automatically created P-Points acc. to ECE
- Visualization of the measured angle and maximum possible angle
- Visualizes the construction geometry

## Result

- Visualization geometry and measured angles
- Check result for obstruction values for left and right side





# CAVA Vision – Vision Points

The standard UNECE-R125 defines six points which must be positioned in the transparent area of the windshield. Therefore, it is important for the designer to determine the position of these points already when designing the windshield.

## Supported standard

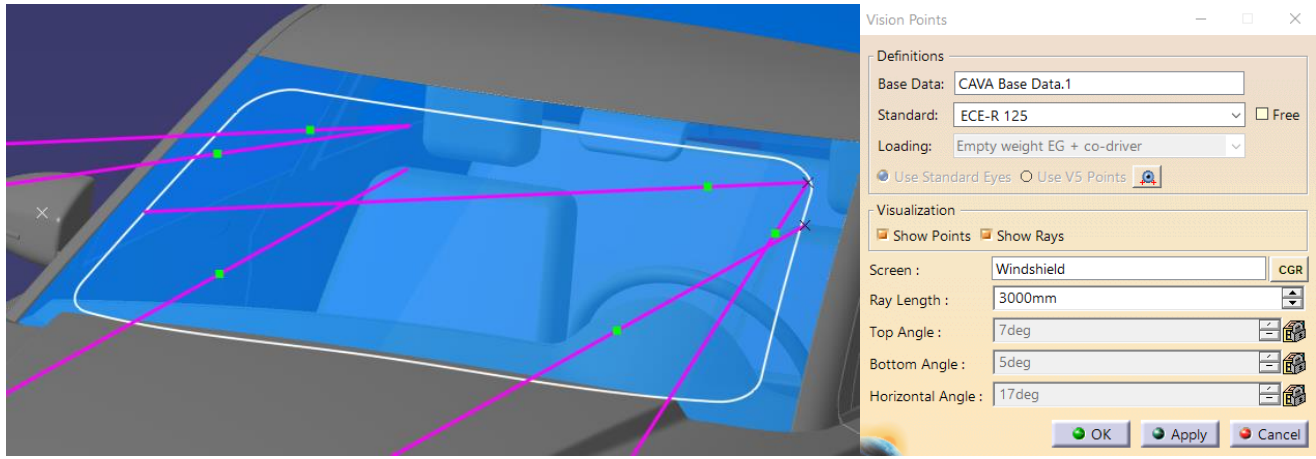
- ECE-R 125

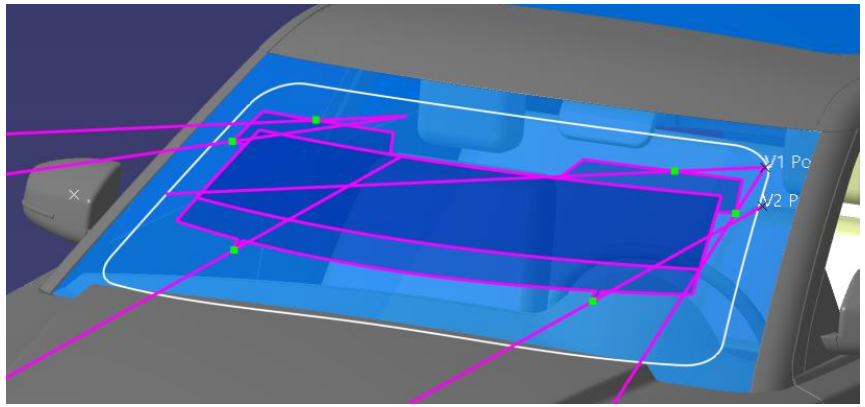
## Features

- Determines the reference points on the windshield based on the V-Points
- Display of the sight rays based on angles from the standard

## Result

- Reference points on the windshield
- Sight rays from V points through the reference points



# CAVA Vision – Vision Planes

In the Standard UNECE-R 125 planes are defined starting from the V-points. Between the planes there must be no view obstructions. There are exceptions for steering wheel, and some obstruction is allowed in the defined “Area S”.

## Supported standard

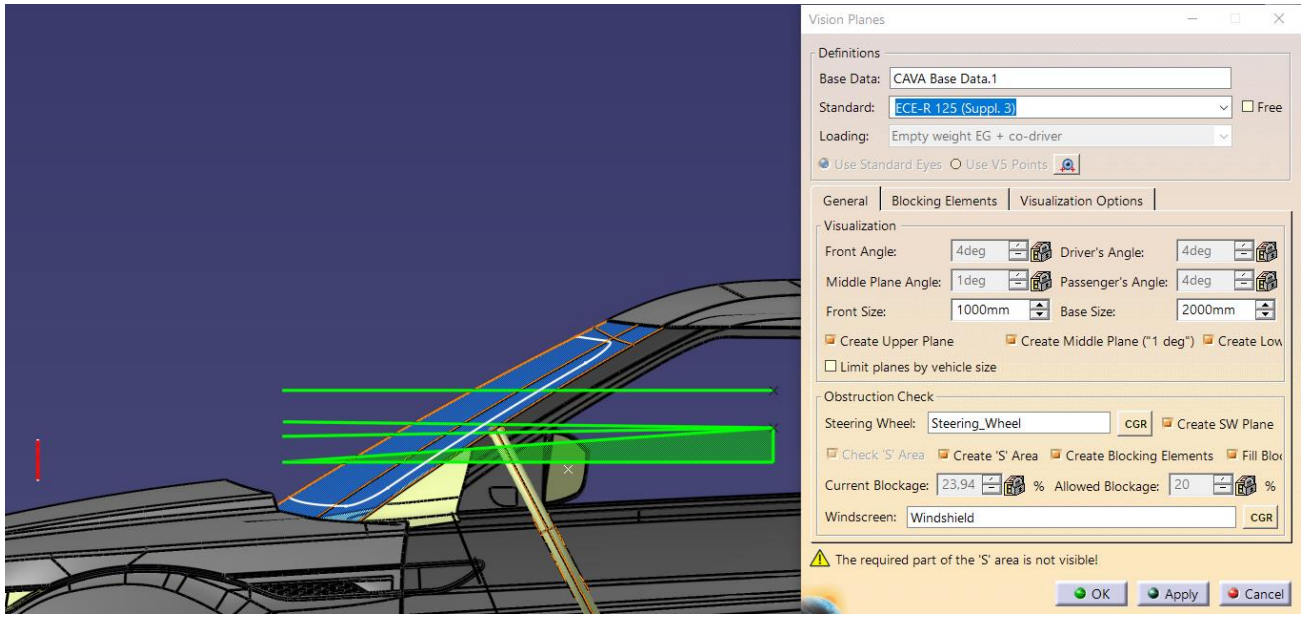
- ECE-R 125

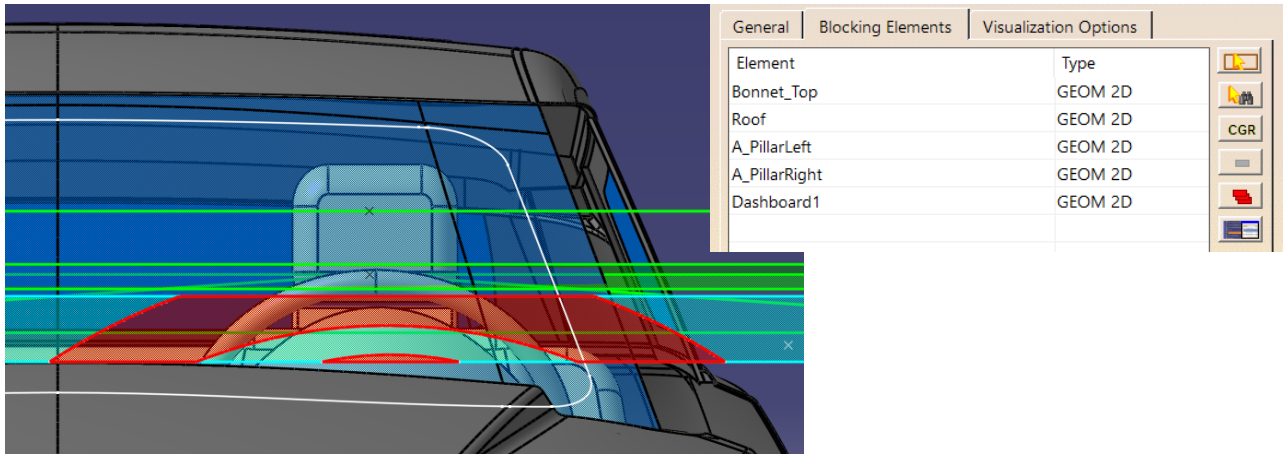
## Features

- Creates the plane limits of the obstruction free zone
- Checks if obstructions occur in the forbidden zone
- Checks the steering wheel height specifically
- Visualizes obstructed areas in “Area S” and calculates the obstruction percentage

## Result

- Visualization of reference planes and Area S
- Check result for obstruction in the forbidden zone
- Check result if the allowed obstruction value in  Area S is violated



# CAVA Vision – Optical Properties of the Windshield

A windshield needs to comply with regulations with respect to optical quality in the A-Field and B-Field. With CAVA you can measure and visualize the **optical distortion** and the **double image angle** and check if the actual values are within the given limits.

## Supported standard

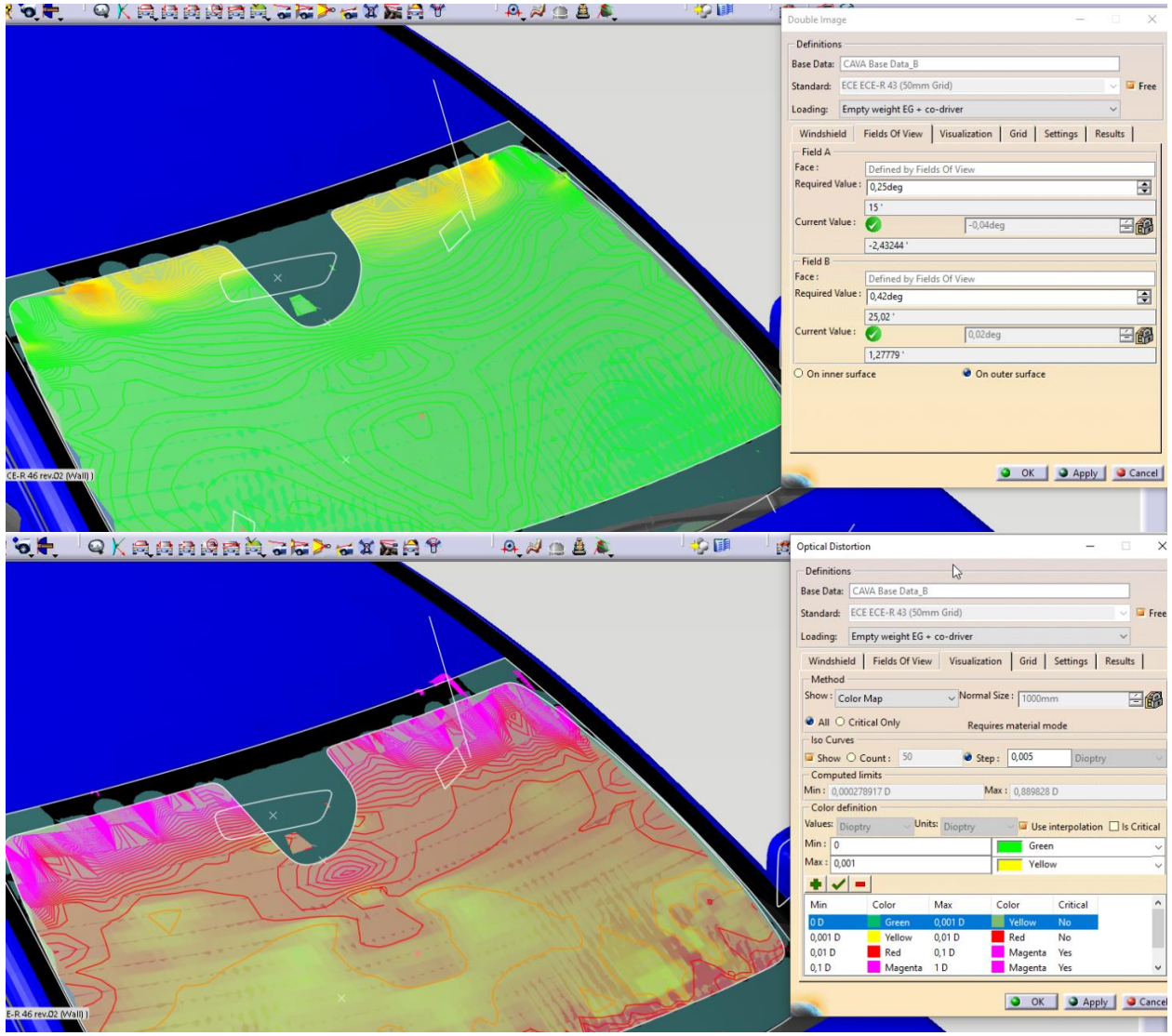
- ECE-R 43

## Features

- Visualizes the measured values as color coded feedback
- Shows isoline on the windshield
- Automatically creates a windshield for the given thickness
- Double angle calculation can consider the correction by non–uniform glass thickness with a given wedge angle
- Interactive measurement of user selected points

## Result

- Check result if optical distortion and double image angle is within the limits of the regulation



# CAVA Vision – Rear View Mirror

The CAVA Mirror function shows the fields of vision through the rearview mirror, including measuring possible obstructions. In addition to checks of the homologation requirements, you can easily check how changes to individual mirror parameters affect the field of vision.

## Supported standard

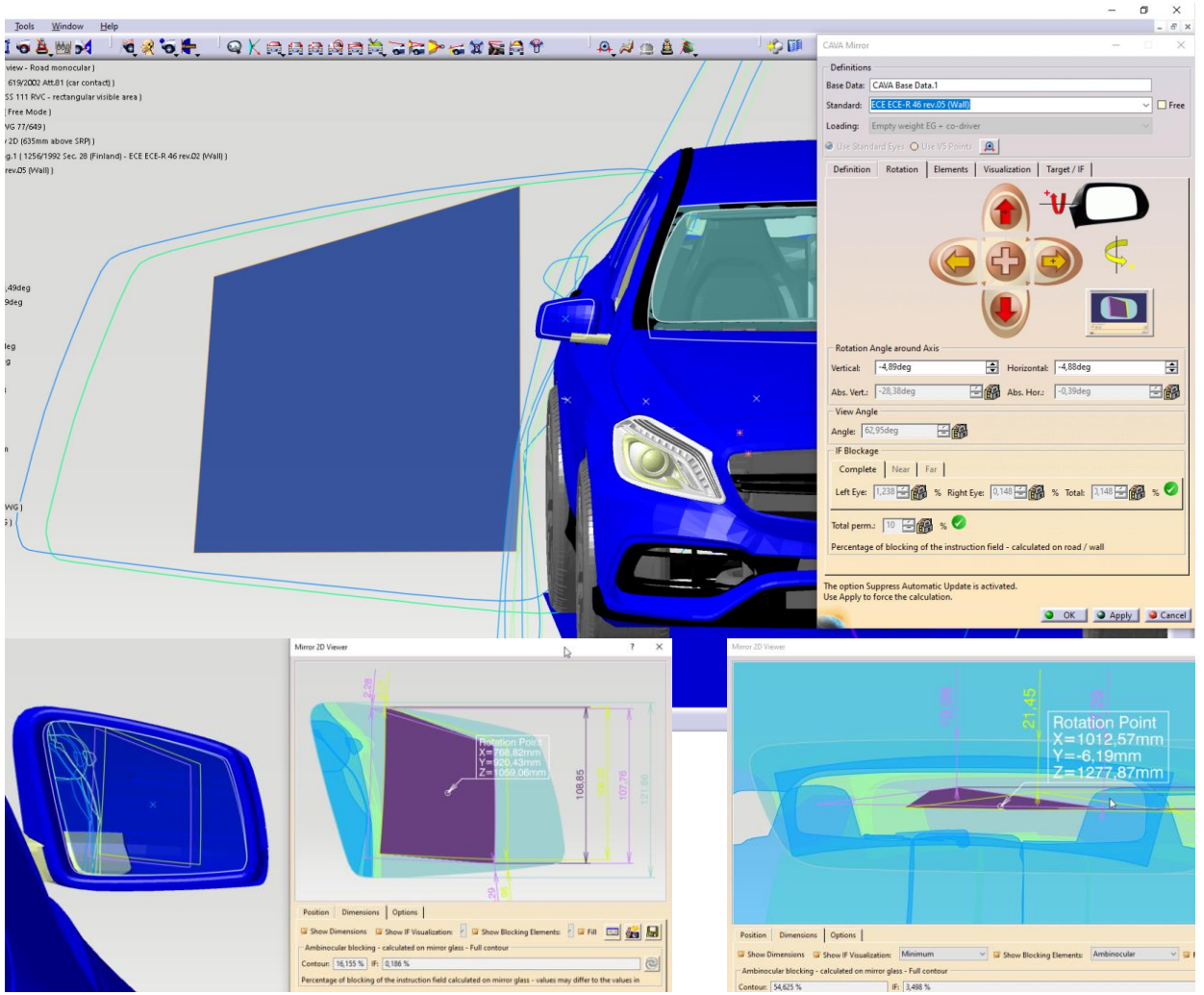
- ECE-R 46, FMVSS 111, GSO
  - Standards with instruction fields on road and on wall

## Features

- Shows the ambinocular field of vision of the mirror
- Parametrical mirror definition (planar, spherical, toroid and aspherical) or definition by selected surface. Available for exterior and interior mirrors.
- Visualizes and measures obstructions by the car geometry
- Visualizes the resulting vision cone

## Result

- Check result if complete instruction field is in field of vision
- Check result for % of allowed obstructions
- Check result for mirror parameters



# CAVA Vision – General Mirror

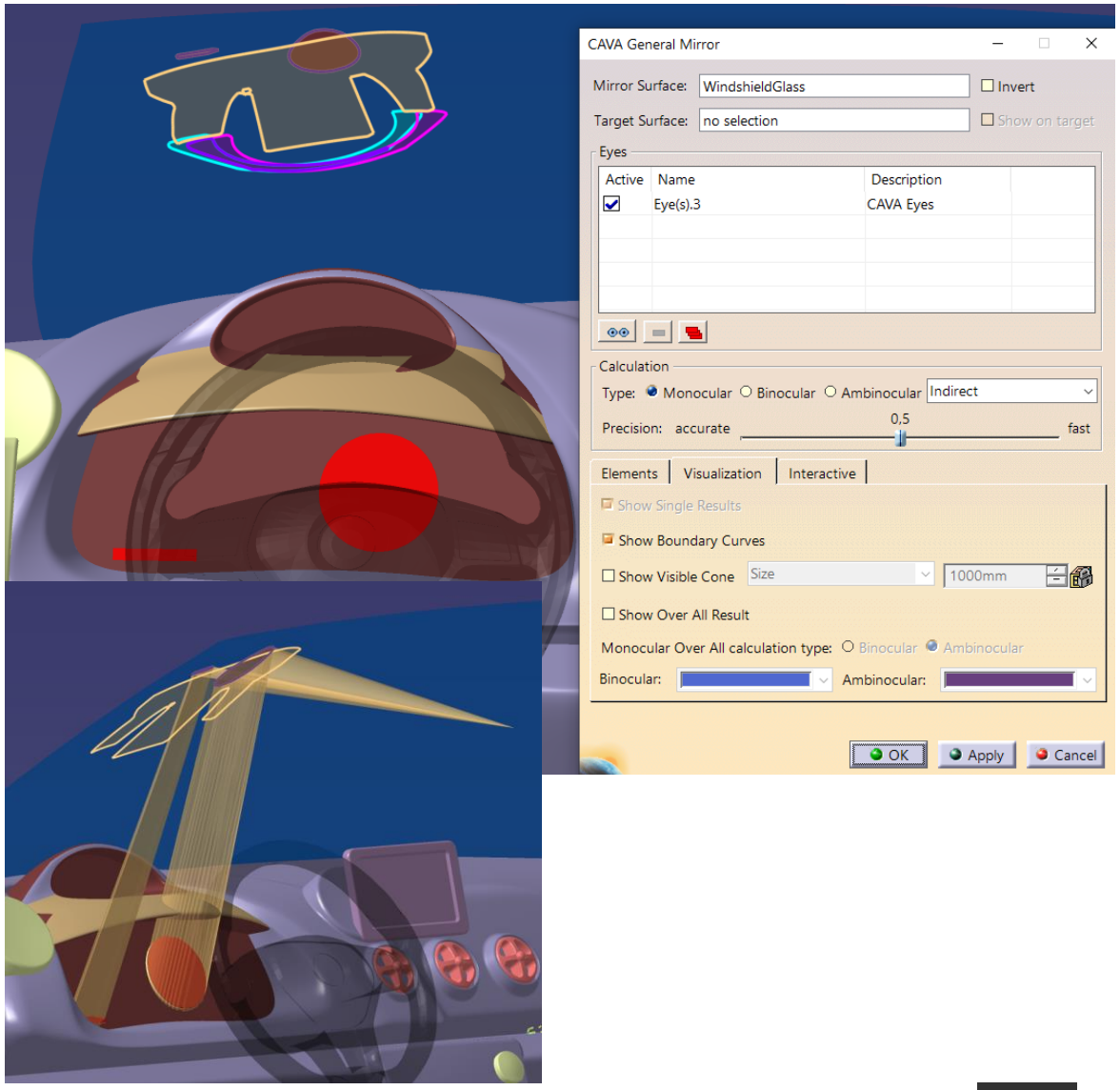
This function enables the user to detect mirroring reflections of specular or illuminated interior elements in the glass surfaces like windshield or the side windows.

## Features

- Shows the reflection of selected elements in the screen
- Use multiple eye-positions for drivers of different sizes
- Monocular, binocular and ambinocular result
- Shows the vision cone to the reflecting elements
- Detect if the reflecting or illuminated element is covered by a glare shield
- Interactive vision ray check of selected point on screen

## Result

- Visualization of reflection on the windshield
- Visualization of the vision cone



# CAVA Vision – Direct View

This CAVA function checks the view in a defined direction, e.g. to the front, rear or to the side.
The aperture angle between the possible top and bottom vision rays is determined by the window opening. The limiting geometry of the vehicle can be taken into consideration.

## Standards

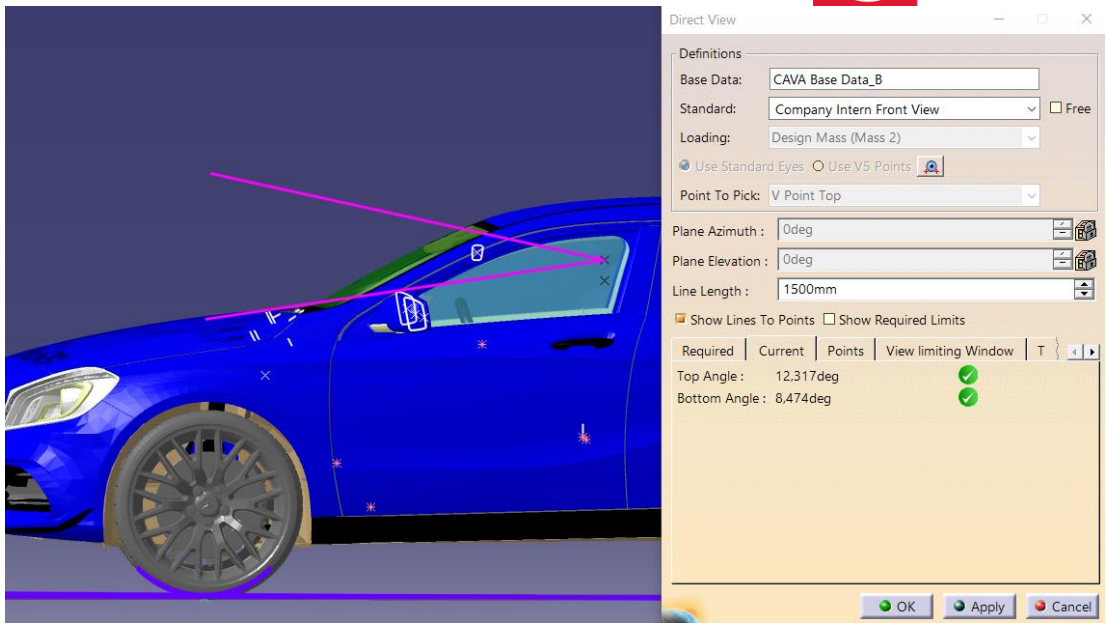
- GCIE A124-1-U
- GCIE A123-1-U & GCIE A123-1-L (Front)
- GCIE A123-2-U & GCIE A123-2-L (Rear)

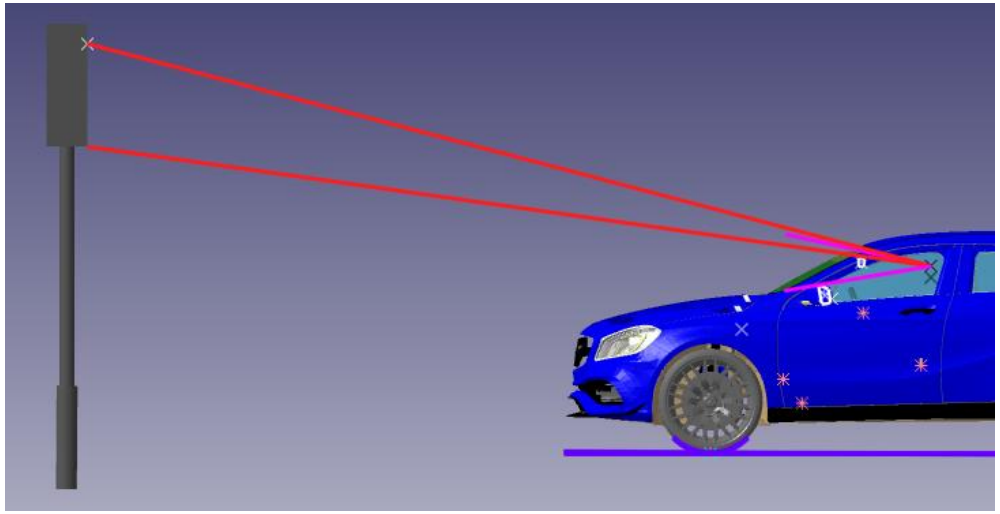
## Features

- Calculates upper and lower view angle
- Visualizes the maximum angle sight rays
- Checks visibility of user selected point for requirements like the visibility of a traffic light

## Result

- Check result if required angles are achieved



# CAVA Vision – Direct View 3D

Create the obstructed areas on the road or on a wall around a car from the driver's viewpoints. Analyze and detect obstructions from the steering wheel on the dashboard.

## Practical Application Standards:

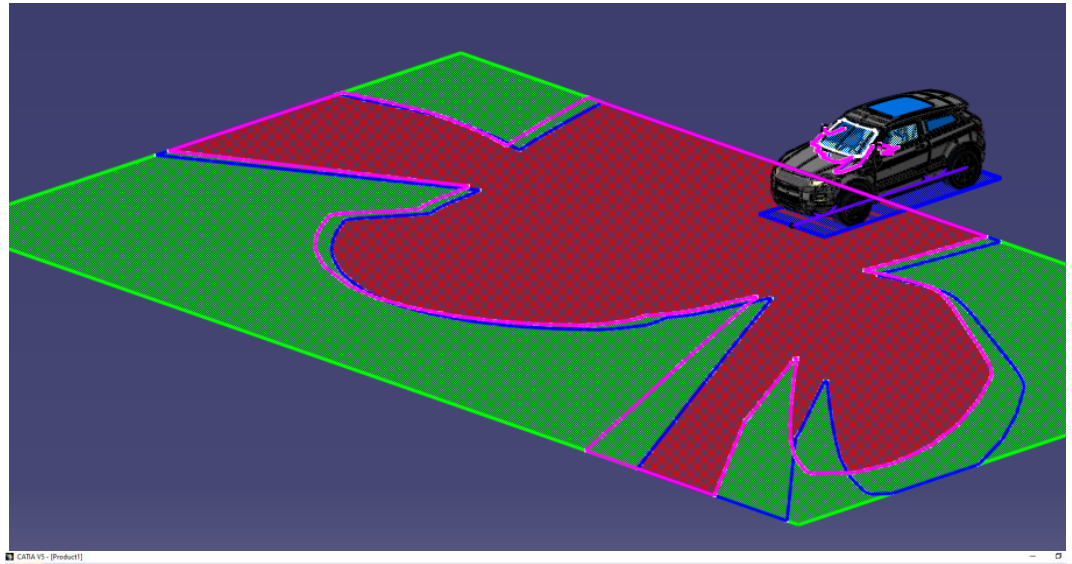
- All-round Vision
- Vision on the road to the Front

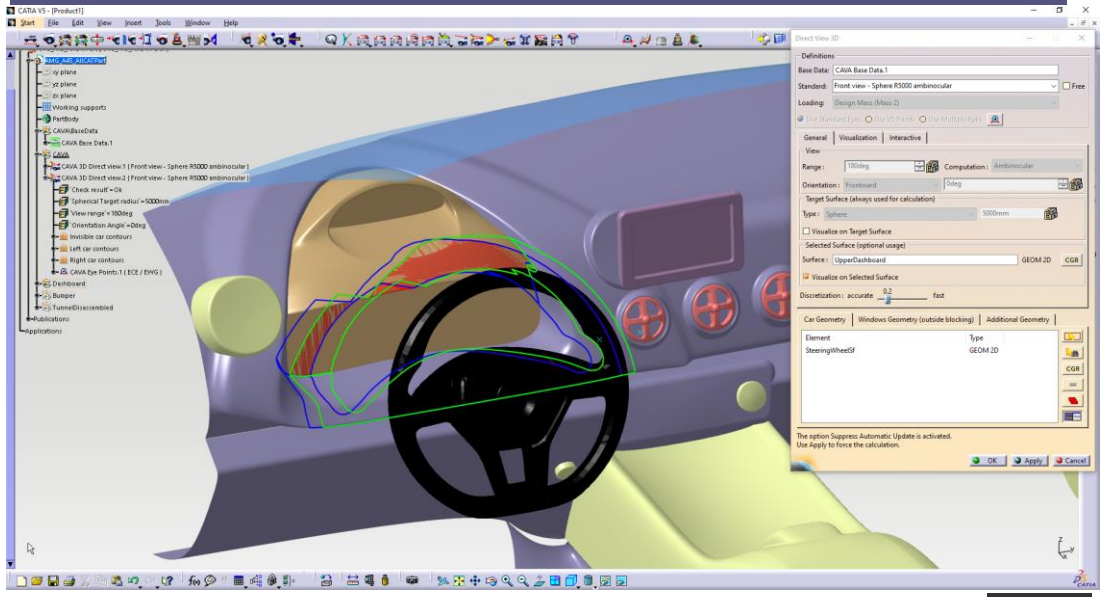
## Features

- Calculate the vision boundaries ("shadow lines")
- Calculate obstructed and visible area on a target surface
- Create monocular or ambinocular vision
- Visualize the resulting vision cone
- Create the "hood line"

## Result

- Calculation of all vision boundaries
- Create an overall result for multiple eye positions





# CAVA Vision – Camera Field of View

Calculates the vision cone for a camera and visualizes the visible areas on the road, wall or other objects.
Calculates the combined view of a set of cameras ( like for artificial “surround view”).
Applicable for optical cameras but also for similar sensors like ultrasound and thermal imaging and radar.

## Supported standard

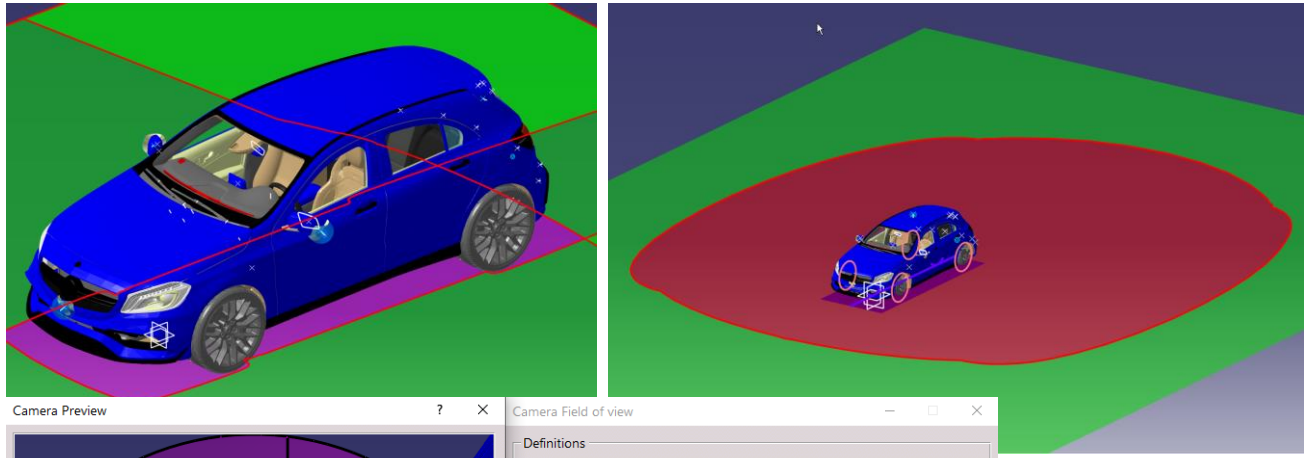
- ECE-R 46 (IF visibility and obstruction value)

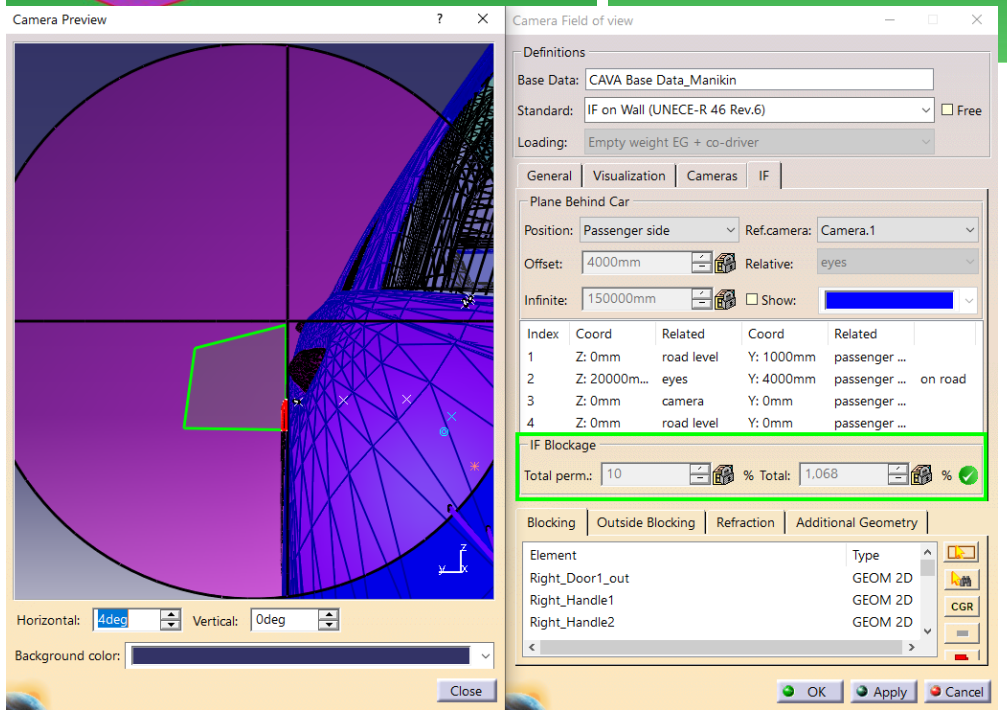
## Features

- Calculate the vision boundaries (“shadow lines”)
- Calculate obstructed and visible area on a target surface
- Create combined vision of multiple cameras
- Visualize the resulting vision cone
- Supports user defined vision cones: conical, pyramidal, custom by section or surface, LIDAR
- Camera Preview Window

## Result

- Resulting Field of View boundaries and areas
- CMS Rear View: Check result for % of allowed obstructions





# CAVA Vision – Close Range Visibility

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

## Supported standards

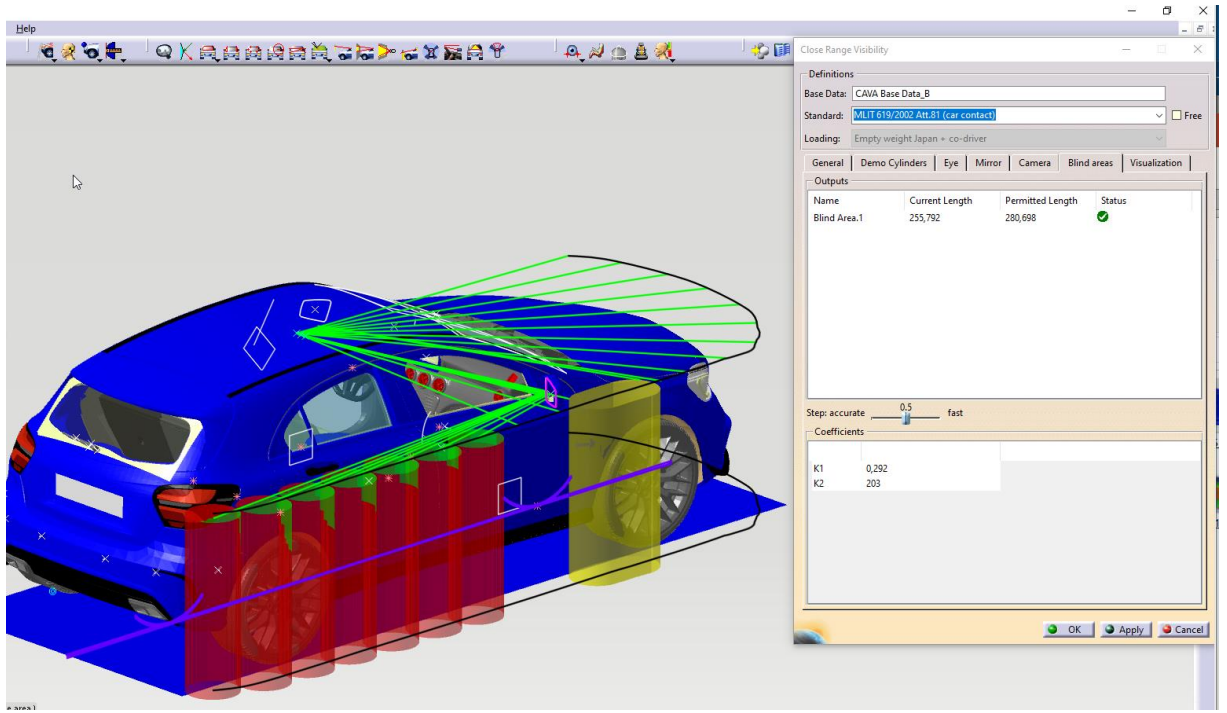
- MLIT 619/2002 Att.81
- ECE-R 125 Frontal Field
- FMVSS 111 and ECE (Rear View Camera)

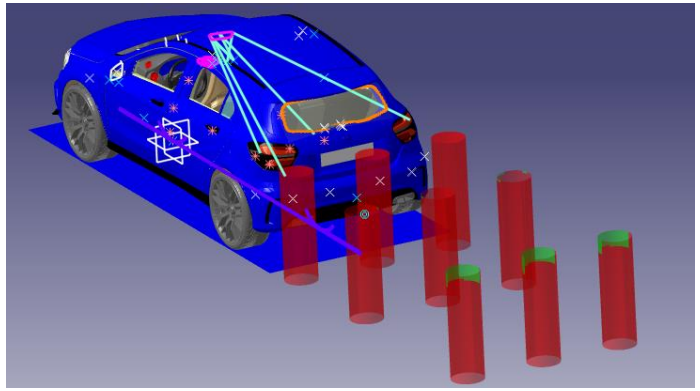
## Features

- Detects and measures the Blind Area according to MLIT
- Support specific eye point definition for MLIT regulation
- Shows the visible and non-visible areas on the test cylinders
- Combines direct vision, mirror vision and camera vision
- Camera definition like in Camera Field of View
- Import Mirror definition from CAVA mirror analysis

## Result

- Check result for MLIT Blind Area and FMVSS111 requirements
- Detailed visibility feedback on the test cylinders



# CAVA Vision – Plan View

Visualization of all around view according to GCIE requirements. Automatic calculation of GCIE pillar obstructions and DLO angles as parameter values.

## Supported standard

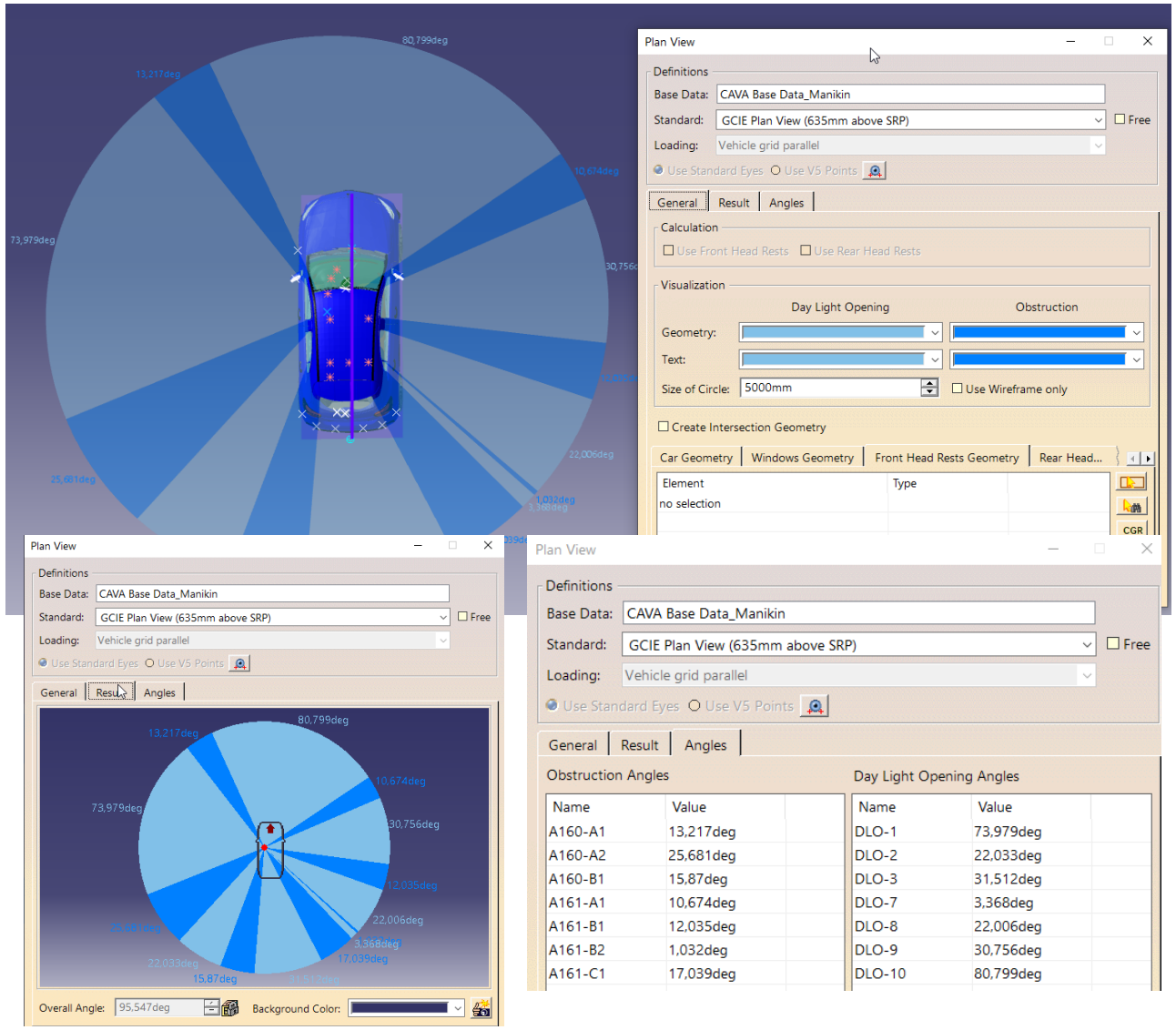
- GCIE Plan View

## Features

- Selection of vehicle, window geometry and headrests
- Customizable display in 2D-View window with capture option
- Obstruction angles and DLO angles calculated as parameters named according to GCIE guidelines

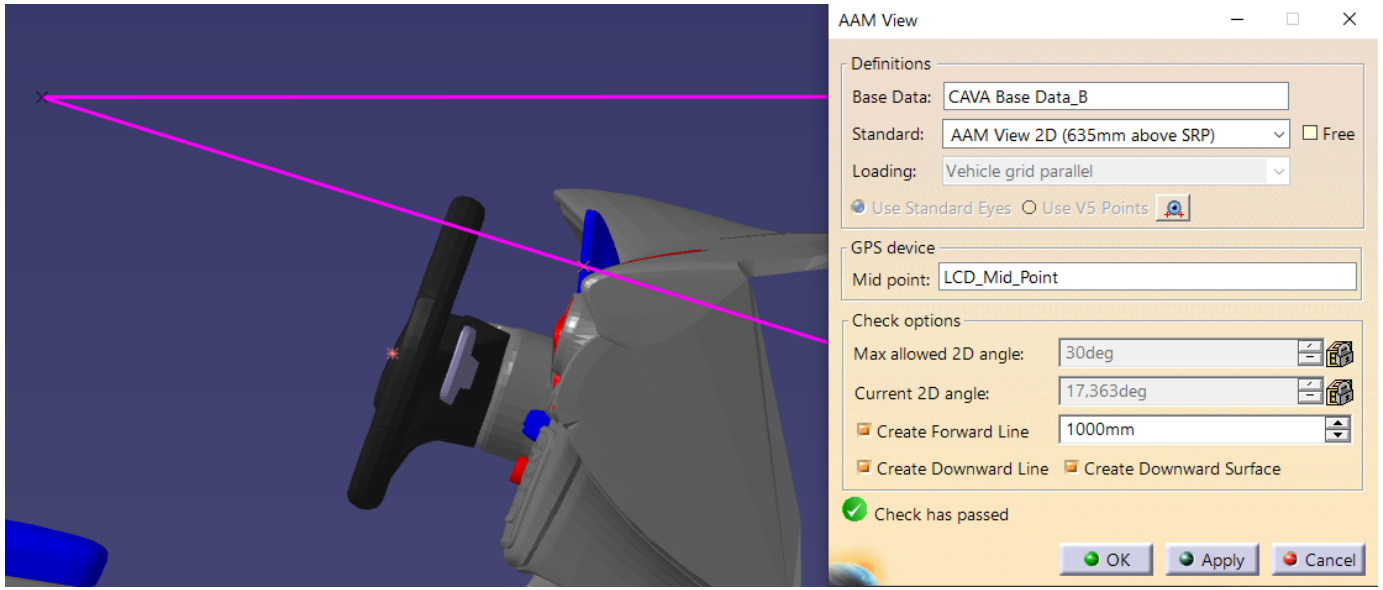
## Result

- Visualization of obstructions and DLO
- Parameters for obstructions and DLO angles
- Calculates overall obstruction angle



# CAVA Vision – AAM View

This feature checks the view to a GPS Device and visualize the required 2D View range.




## Supported standard

- AAM

## Features

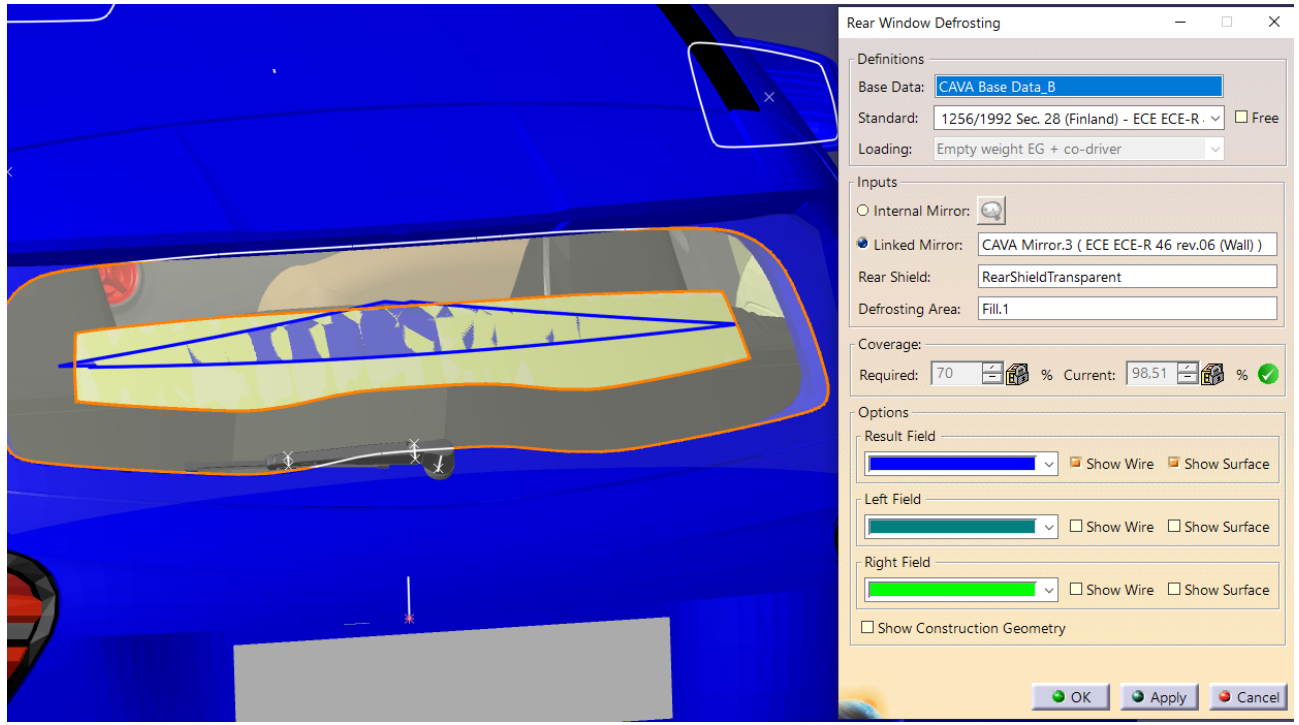
- Shows the sight ray to the navigation device screen
- Visualizes the downward surface
- Measures the vertical view angle

## Result

- Check result if vertical view angle is within given limit

# CAVA Vision – Rear Window Defrosting

The rear window needs to be defrosted so that the area corresponding to the required mirror instruction field, is sufficiently visible. CAVA displays this area and can calculate the coverage value based on the input of the actual defrosted zone.




## Supported standard

- 1256/1992 Sec. 28 (Finland)/UNECE-R 46 rev.06 (Wall)

## Features

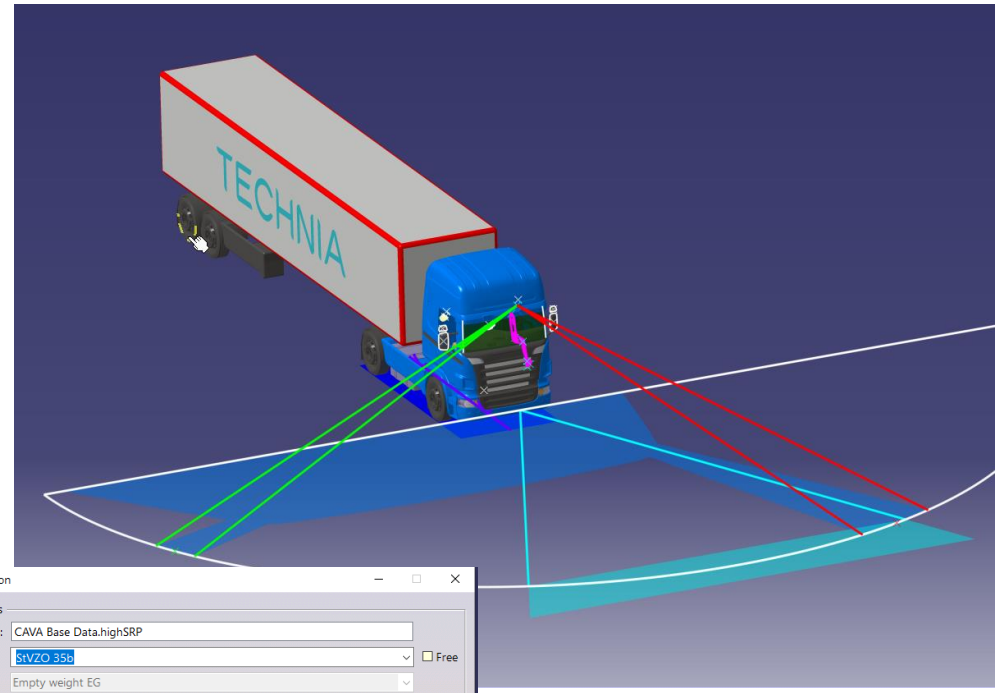
- Shows and creates the area of the instruction on the rear window to be defrosted
- Based on given defrosted area calculates the coverage value

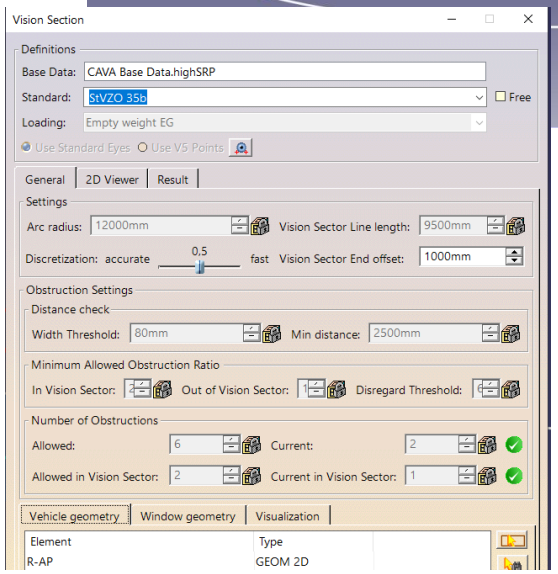
## Result

- Check result if required coverage is achieved

# CAVA Vision – Vision Section

A trucks driver’s direct vision on the road is important for safety of pedestrians.
This feature analyzes the view obstructions on a 12m circle (around a single eye point) on the road.




## Supported standard

- StVZO 35b

## Features

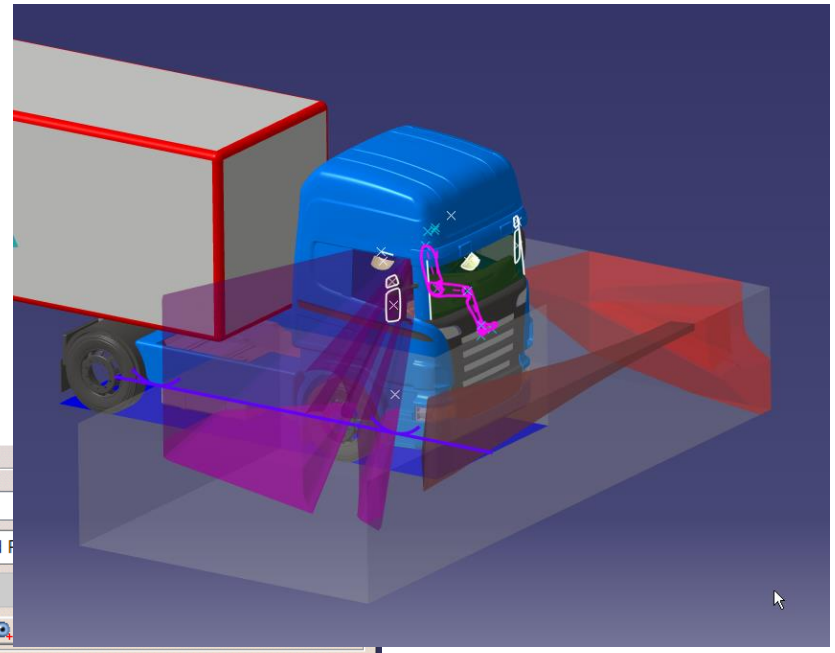
- Calculates number of obstruction on the required circle
- Calculates obstruction ratios in vision sector

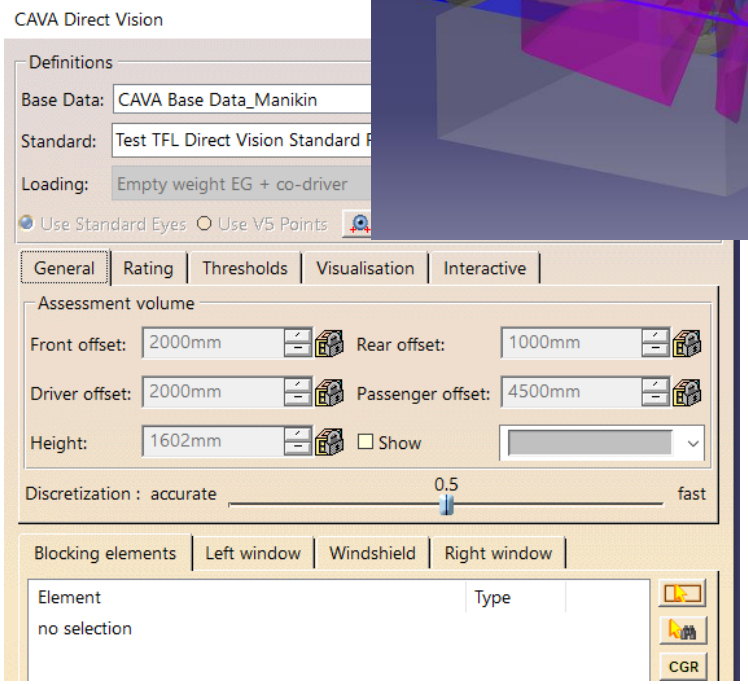
## Result

- Check result if obstruction is within limits of the regulation
- Check result for % of allowed obstructions

# CAVA Vision – Large Vehicle Close Range Direct Vision

The CAVA Mirror function measures the visible ground volume around a truck cabin acc. to directive ECE-003155-1 - Large Vehicle Direct Vision






## Supported standard

- ECE-003155-1 - Large Vehicle Direct Vision

## Features

- Shows the required vision volume around the cabin
- Calculates the visible volume for the front, left and right view direction from the automatically calculated eye points
- Considers obstructions and windows of the vehicle
- Visualizes the resulting vision cone

## Result

- Check result if vision volumes are within the required limits
- Creates the star ratings according to the standard

# CAVA Vision Sub-Product Comparison

| CAVA Feature | Vision | Vision-View | Vision Mirror |
|---|---|---|---|
| Vision Fields on the windshield | ✓ | ✓ | |
| A-Pillar Obstructions | ✓ | ✓ | |
| Vision Points on the windshield | ✓ | ✓ | |
| Vision Planes | ✓ | ✓ | |
| Optical Properties | ✓ | ✓ | |
| DirectView | ✓ | ✓ | |
| Rear View Mirror | ✓ | | ✓ |
| General Mirror | ✓ | | ✓ |
| Direct View 3D | ✓ | | |
| Camera Fields of View | ✓ | | |
| Close Range Visibility | ✓ | | |
| Plan View | ✓ | | |
| AAM View | ✓ | | |
| Rear Window Defrosting | ✓ | | |
| Truck Vision Section and Truck Direct Vision | ✓ | | |