Altair Safety Report Manager

Table of Contents

Altair Safety Report Manager

The Altair Safety Report Manager (aka ASRM) is a fully customizable automatic report generation utility for crash & safety regulations. It allows users to create a First Sight Report PPT for the selected impact type & regulation. The PPT report which consists of plots & animations that are generated based on various inputs entered by the user.

A standard report is delivered for each mode with the following info and contents.

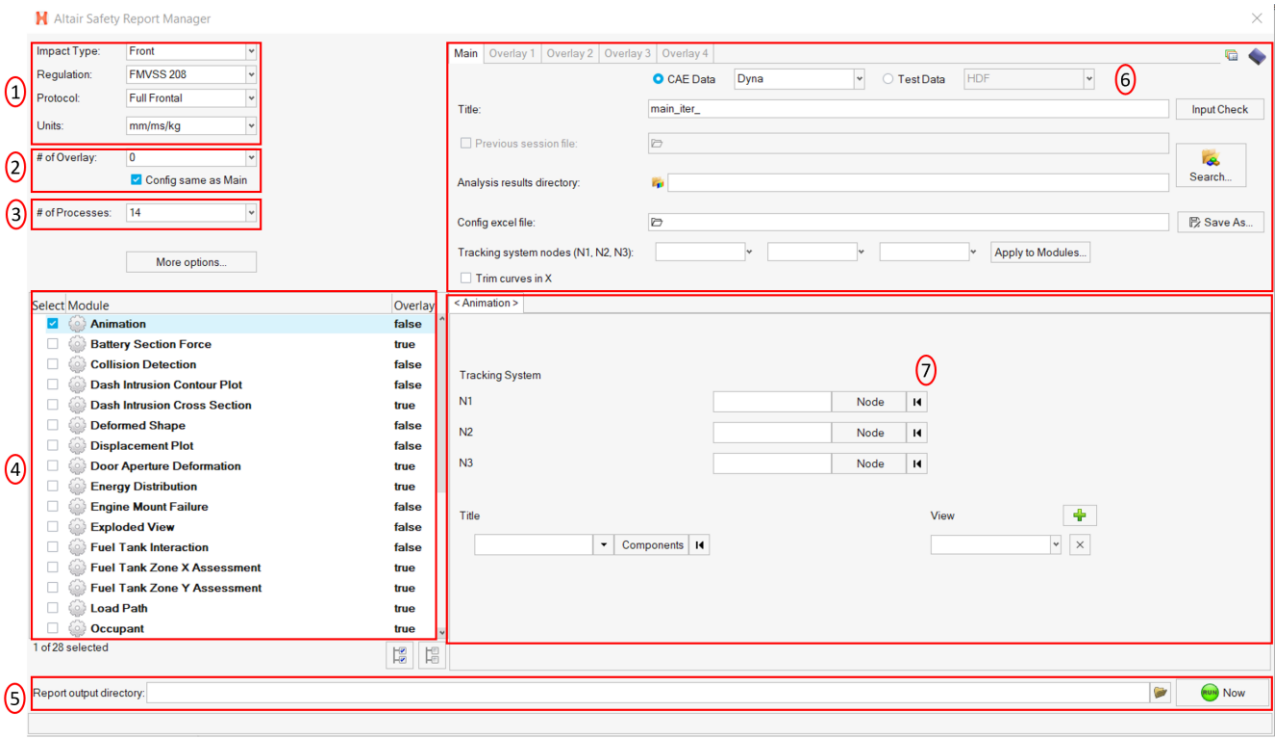
- Model information
- Run quality statistics
- Occupant requirements
- Structure requirements
- Structure overview
- User defined plots

In addition, HyperView template & session files are created at the end of report generation which contains all plots/animations for closer analysis. It has the capability to overlay plots from different iterations. It is also possible to overlay plots with test data in HyperView.

The ASRM utility can also be run on HPC after job completion.

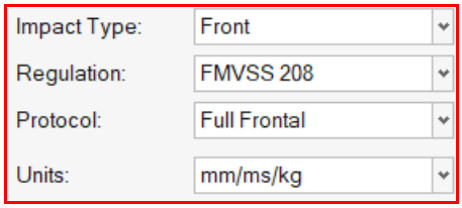
ASRM GUI Overview

Below is a snapshot of the ASRM GUI. To understand the ASRM workflow better, the GUI is divided into various sections as highlighted & numbered in the below picture. The main functionality of all the sections is briefly described below.



Impact Type & Units selection Section

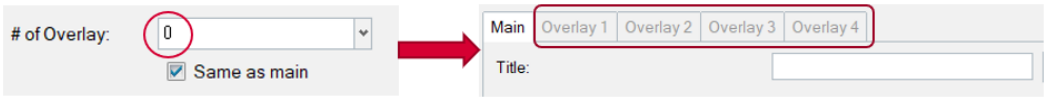
In this section, user will be able to select the Impact Type, Regulation, and the Protocol for which he / she wants to generate the PPT report along with the source units used for running the simulation. Based on this selection the modules list (section #4) gets updated.



Overlay selection section

In this section user will be able to select the overlay option. Following scenarios are supported.

- When you want to generate report for a single run then you would set overlay option to 0. Therefore, overlay tabs (in section #6) is disabled.



- When you want to run in overlay mode, then you must pick appropriate number of overlay runs. The overlay tabs get enabled based on the number selected. User can select up to 4 iterations for overlay.

Please note that only those modules which run in HyperGraph (that create curves / graphs) are supported for overlay mode. There is a specific overlay status column next to modules list that indicates the overlay support for each module.

No. of Processes selection & save session file section

This section allows user to enter the no. of processes to be used when executing the utility. ASRM has the capability to run the report generation in parallel based on the no. of processes selected.

It also saves TPL files and session files at the end of the report generation. Users can also choose to export curves (curves created from the respective plotting modules) into **Excel** format. Click on the **More options…** button to select these options.

Modules list

This section allows users to select the modules to be run for report generation. User must make sure to select the module that he / she wants to include in the report generation.

Output directory selection

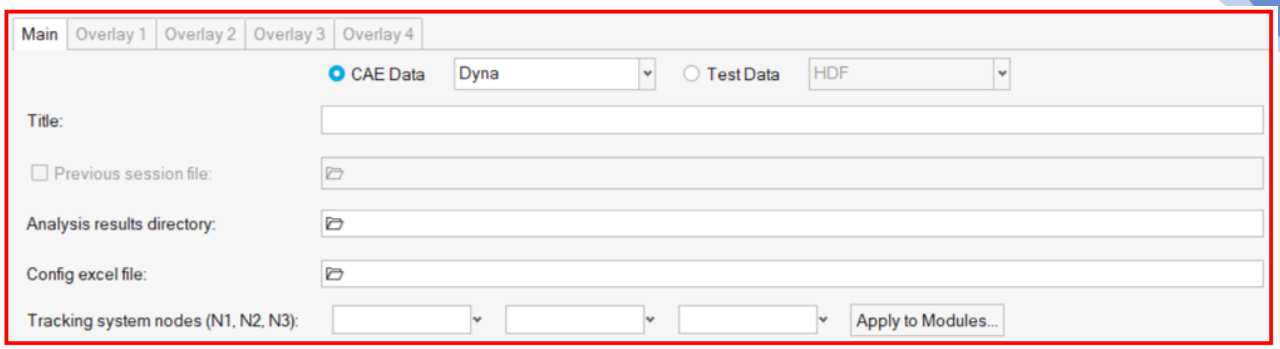
In this section user will select the output directory path. This is where all the output files such as the session files, images, animations, PPT report & log files from the ASRM run will be created.

Main section

Input directory, data type & configuration section

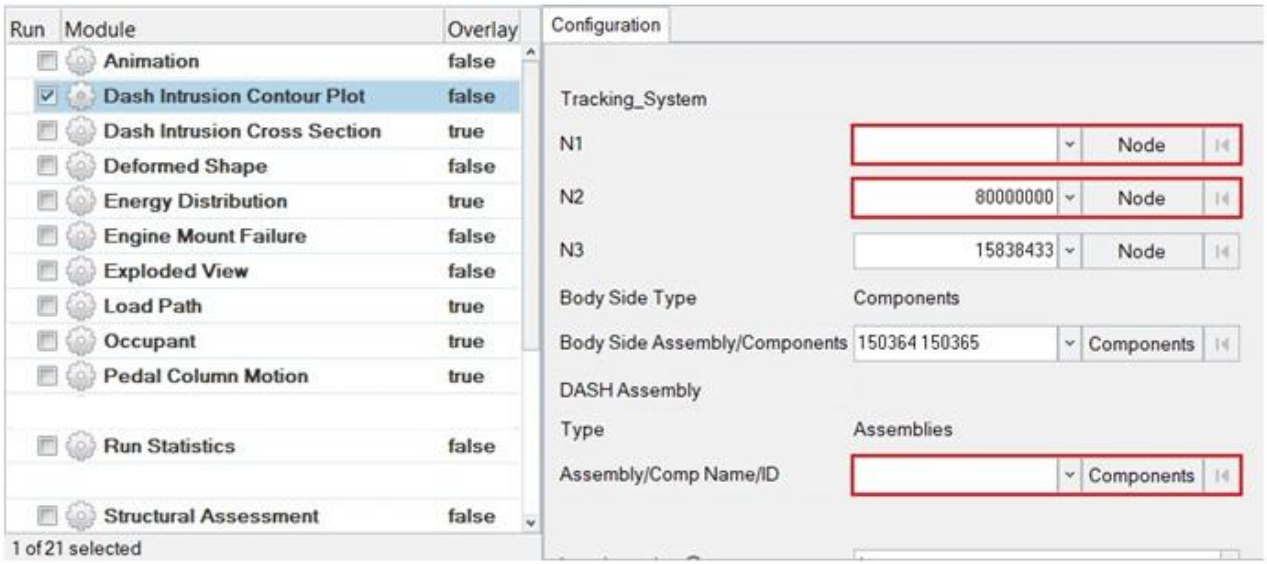
In this section, user should select the following.

- Type of data being used for generating the report. It could be CAE simulation data or physical test data.
- Title for the report which will be used for creating results directory as well as prefix for curve names & summary tables
- Results directory path where the solver input file, results files such as animation & time history files or test data are located.
- Config file path (if it exists already)
- Define global tracking system using 3 nodes (requests from Time history file). This is an optional input. Once the global tracking system is defined, it can be easily applied to other modules where tracking system is an input. Click on **Apply to Modules…** button, a selection dialog pops up, select the modules to apply the 3 nodes, and click **Apply&Close** button.



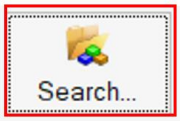
Input Validation check

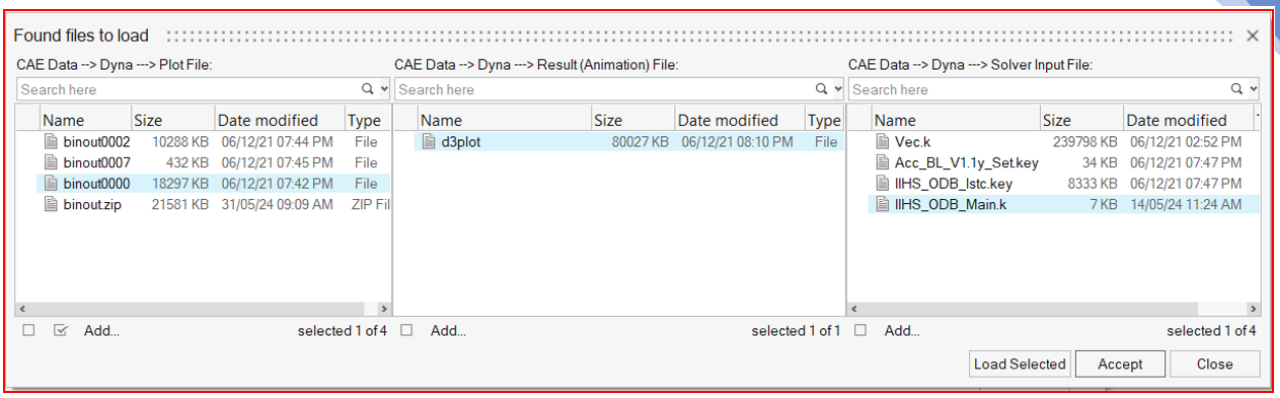
Input Check button would run a quick validation check to verify if the inputs defined for selected modules is valid. The verification is done on the results files available in the input directory specified. Any invalid inputs and missing input found from validation check will be highlighted in RED in the ASRM GUI as shown below.



Search function

Search button will let users to select and import the 2D time history file (CAE (T01 / binout) or physical test data (HDF / ISO MME)) as well as main solver input file and the 3D animation results file into the current session. This is required for defining the inputs for all the modules. An additional dialog called **files to load** will be displayed to select the files as shown below.

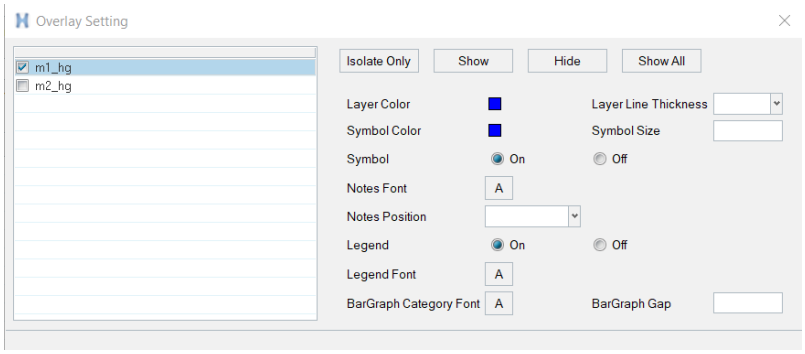




Change curve attributes & publish session

This section is mainly used for the overlay scenario.

The change curve attributes option  brings up an overlay setting dialog as shown below. This will allow to change various curve & note related attributes for the overlay session per layer basis.

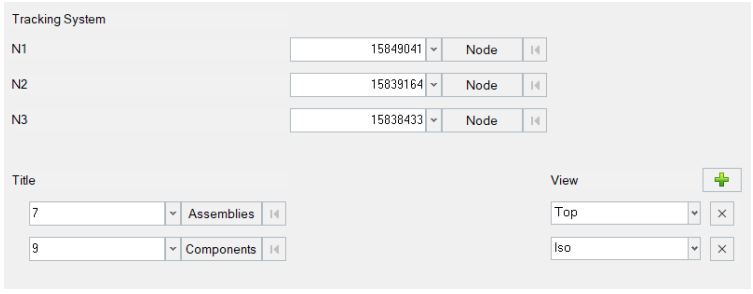


After changing the curve & note related attributes using the overlay setting dialog, user can click on Publish session icon  which would publish a report for the overlay session.

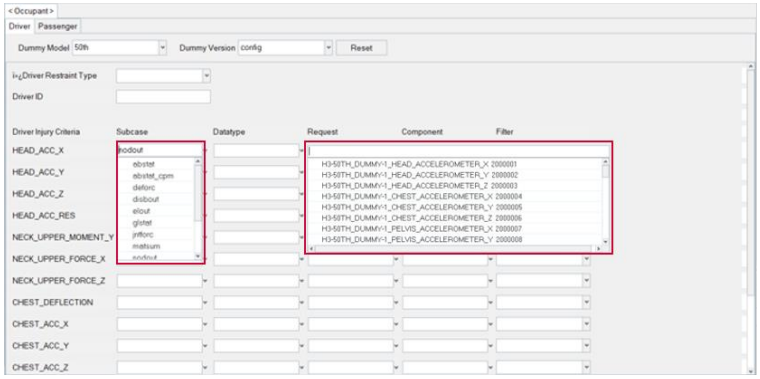
Configuration section

This is the section wherein the inputs required for all the modules will be entered & displayed. For defining the inputs, firstly make sure to load both the 3D (solver input file) file as well as Time History file using the **Search** button. Then start defining the inputs for the modules.

FE entities such as nodes, components or assemblies can be selected from graphics screen from the loaded solver input file.



Inputs from the Time History files (subcases, requests & components) can be selected from the drop-down context dialog as shown below.



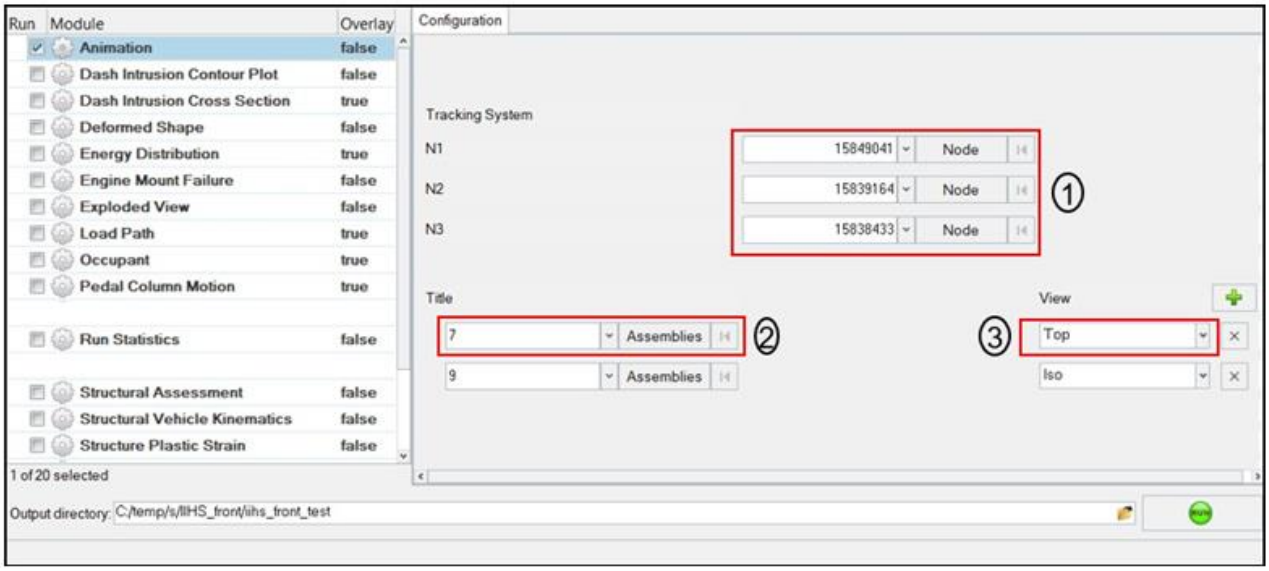
Modules

Following is the list of modules supported by ASRM utility for front impact type.

- Animation
- Animation New
- Battery Section Force
- Contour Plot
- Dash Intrusion Contour Plot
- Dash Intrusion Cross Section
- Deformed Shape
- Energy Distribution
- Engine Mount Failure
- Exploded View
- Load Path
- Measure Plot
- MPDB Intrusion
- Occupant
- ODB Intrusion
- Pedal Column Motion
- Rocker Pulse
- Run Statistics
- SORB Intrusion
- Structural Assessment
- Structural Vehicle Kinematics
- Structure Plastic Strain
- User Defined Outputs
- Vehicle Kinematics Vertical
- Vehicle Kinematics XY Displacement
- Weld Failure
- Wheel Kinematics

Animation

Animation module lets you create gif animations of the selected parts (or assemblies) in the user selected standard views.



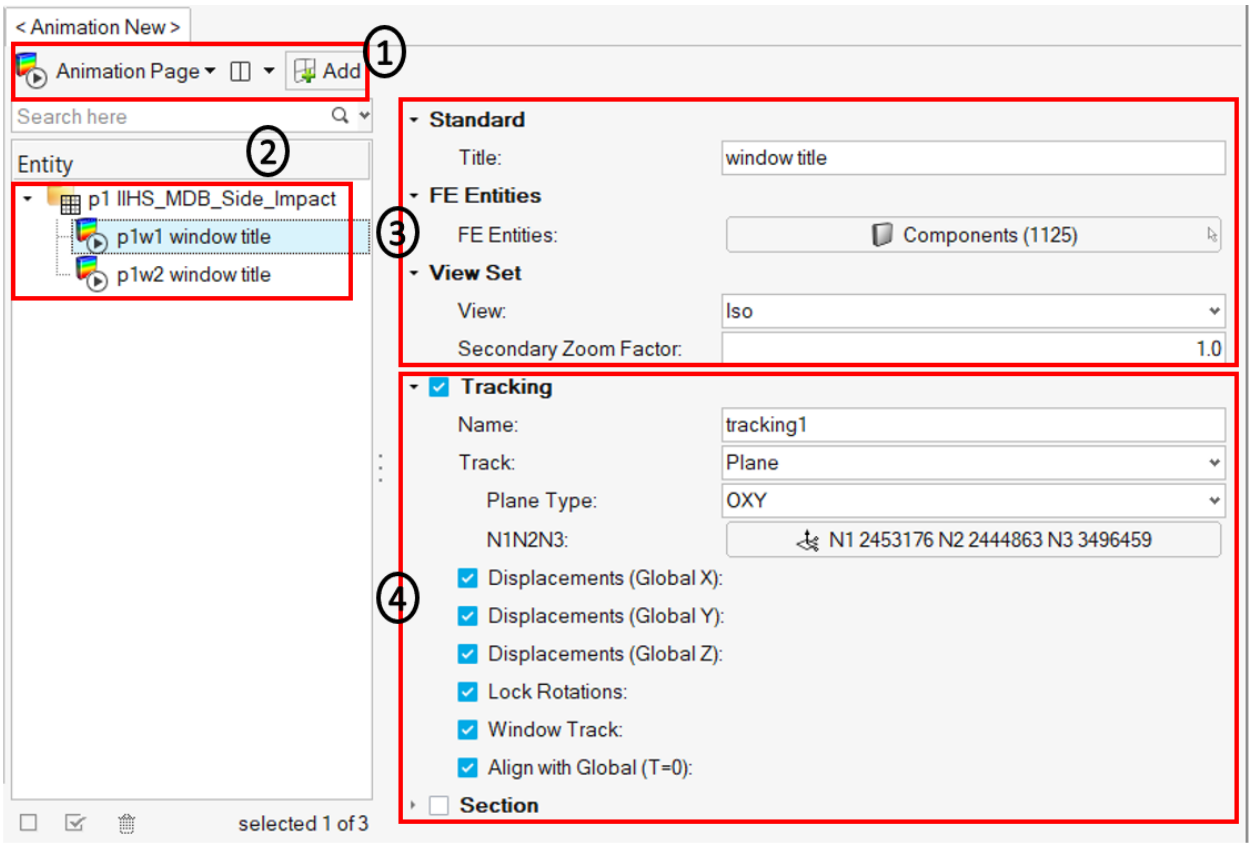
Inputs:

1) Node ID 1, 2 & 3 for defining tracking system
2) Part ID or Assembly ID to be used when capturing gif animations
3) One of the standard views to be used when capturing the gif animations for the part or assy ID selected in step #2

Output report:

Animation New

This module lets you capture animation of the selected parts (or assemblies) and offers flexibility in terms of page layout, view orientation, tracking and section cut. The GUI and the various inputs that are required to be defined are mentioned below.



Inputs:

1) Use this input to select the page & window layout that will be captured and included in the report. 2 layouts are supported i.e. 1 x 1 and 1 x 2. Select the layout and click on **Add** button to add the page layout into the entity list browser.
2) The **Entity** list browser is used to list and manage the pages included by the user and their respective layouts.
3) Enter the **Title** used for the slide title in the report, select the **Components** to be used for the current page and the **View Set** to be used to orient the components.
4) Define **Tracking system** & **Section cut** details along with its attributes to be applied while generating the report.

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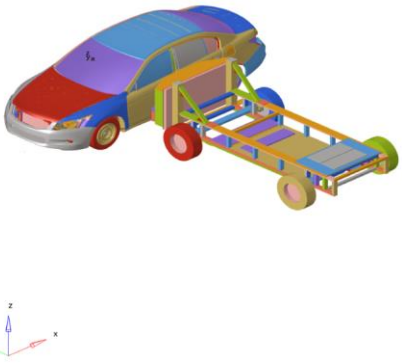
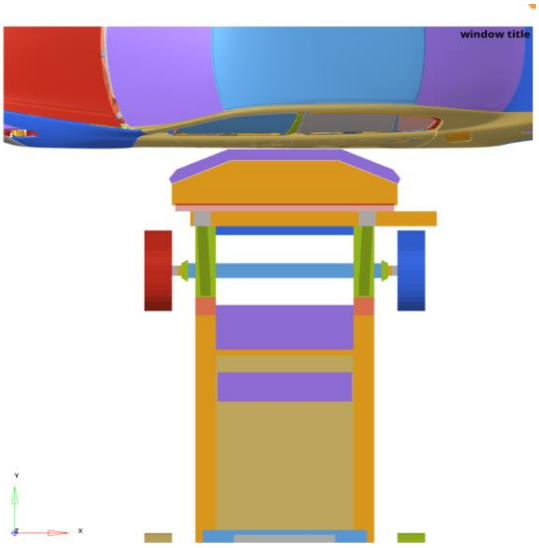
IIHS MDB Side Impact

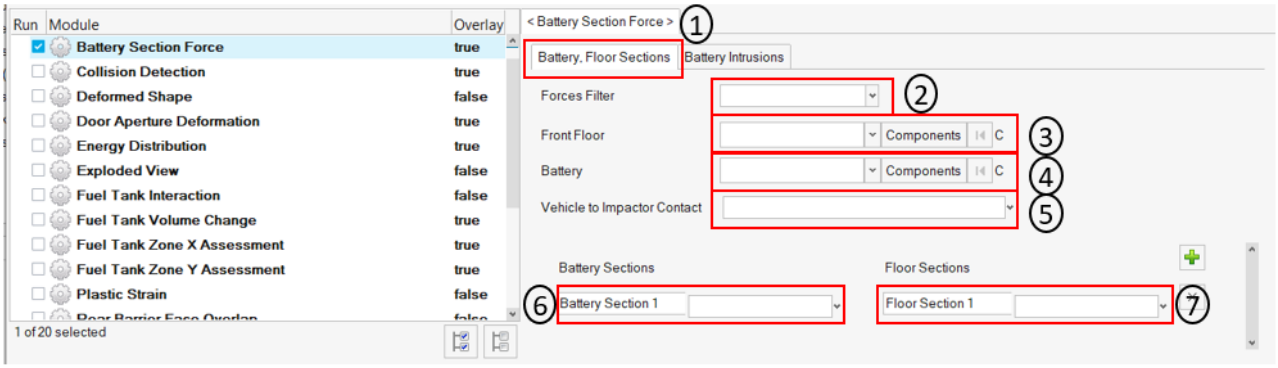


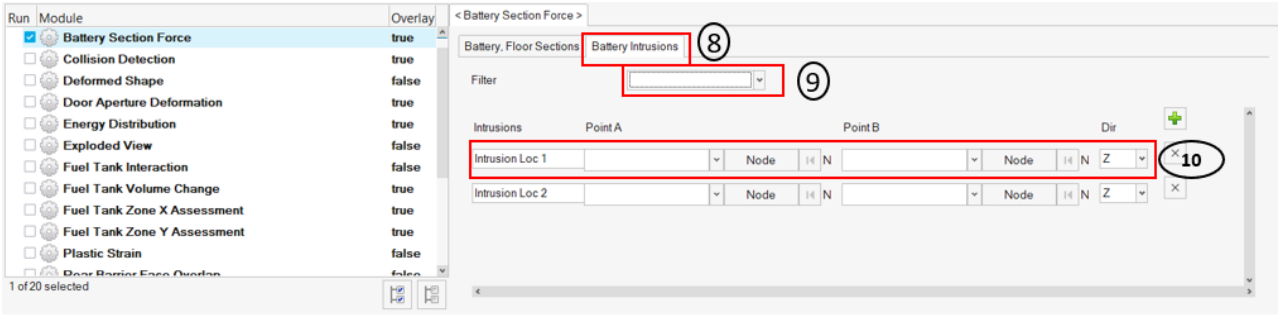


Battery Section Force

Battery Section Force module lets you create a summary report of battery and floor cross member section forces and battery intrusion measurements. The report consists of following.

1) Images consisting of floor and the battery parts along with cross section members
2) A summary table showing the cross-member forces for all the user defined battery & floor sections
3) A summary table showing the battery intrusion measurements at various user selected locations
4) Images of the plots showing the battery & floor section forces along with the total floor & battery crossmember forces. Battery intrusion plots are also created at all the user selected locations.

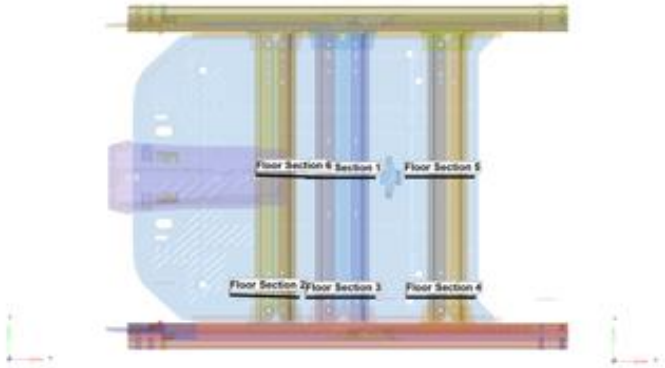


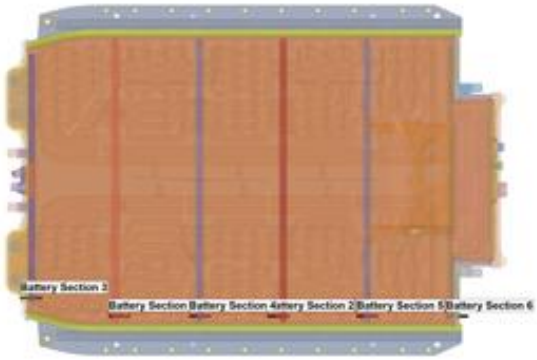


Inputs:

1) For battery & floor sections, following inputs are required.
    a. Filter class to be used for applying the filter to battery & floor cross member section forces plots
    b. Front floor & battery components or assemblies
    c. Vehicle to Impactor contact request
    d. User defined battery & floor sections
2) For battery intrusion measurements, following inputs are required.
    a. The source & target intrusion measurement locations. It could be either Node, Element or Component.
    b. The measurement direction (X/Y/Z)

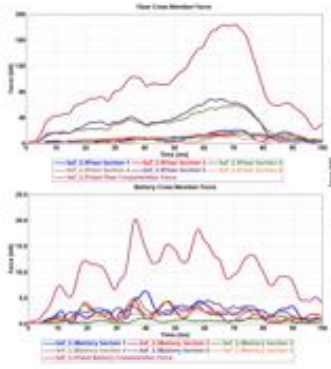
Output report:

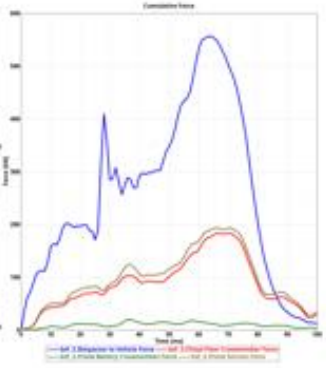


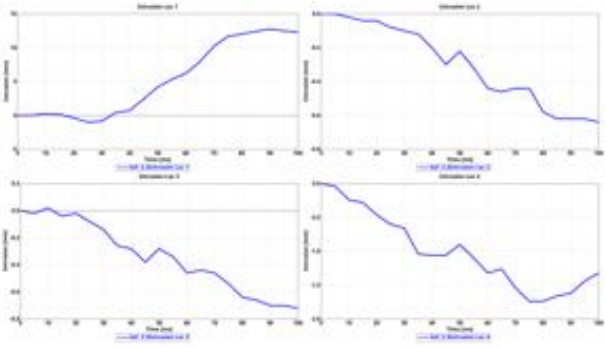


Battery Cross Member Force		Floor Cross Member Force	
Title	Force [kN]	Title	Force [kN]
Battery Section 1	6.37	Floor Section 1	20.89
Battery Section 2	4.44	Floor Section 2	16.18
Battery Section 3	1.07	Floor Section 3	15.36
Battery Section 4	5.10	Floor Section 4	58.88
Battery Section 5	4.56	Floor Section 5	68.69
Battery Section 6	2.56	Floor Section 6	14.13

Battery Intrusion	
Title	Intrusion [mm]
Intrusion Loc 1	12.78
Intrusion Loc 2	0.64
Intrusion Loc 3	0.72
Intrusion Loc 4	1.74

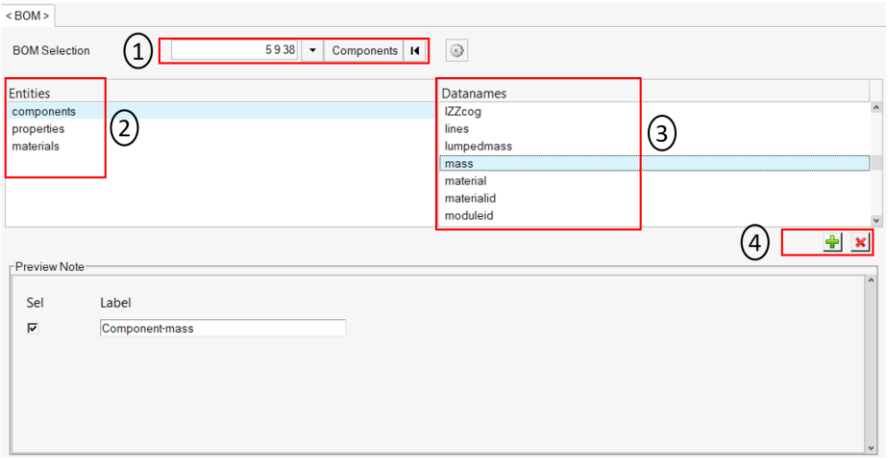






BOM

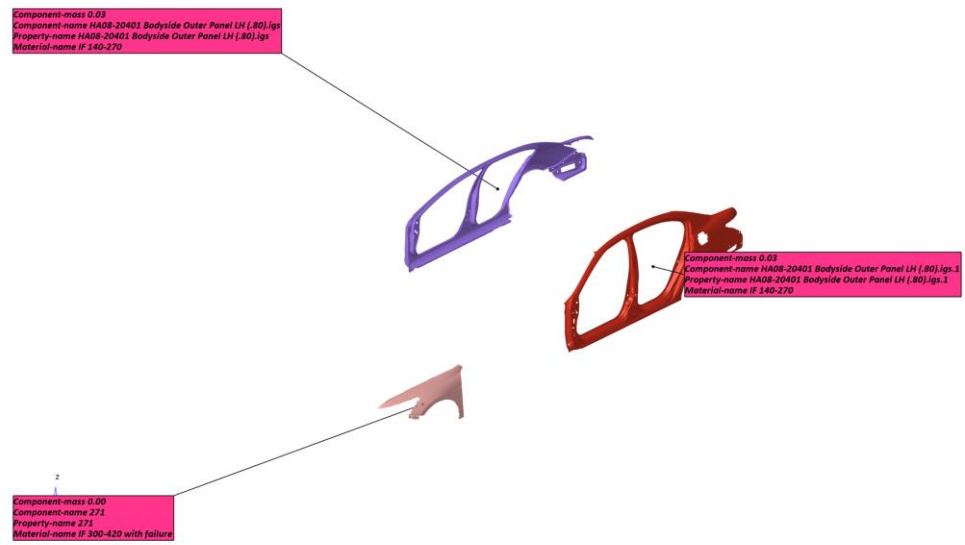
BOM module is an advanced exploded view module. It has the capability to include data name attributes as annotations in the report. Users can pick from several data names (around 100) related to components, property, and material entity attributes. The selected BOM info can be easily attached as annotations to the components in the exploded view.



Inputs:

1) Select the assembly IDs or components IDs that should be included in the BOM report
2) Select the entity type for which the data name attribute should be searched
3) Select the appropriate data names from the list
4) Click on + icon to add the selected attribute

Output report:

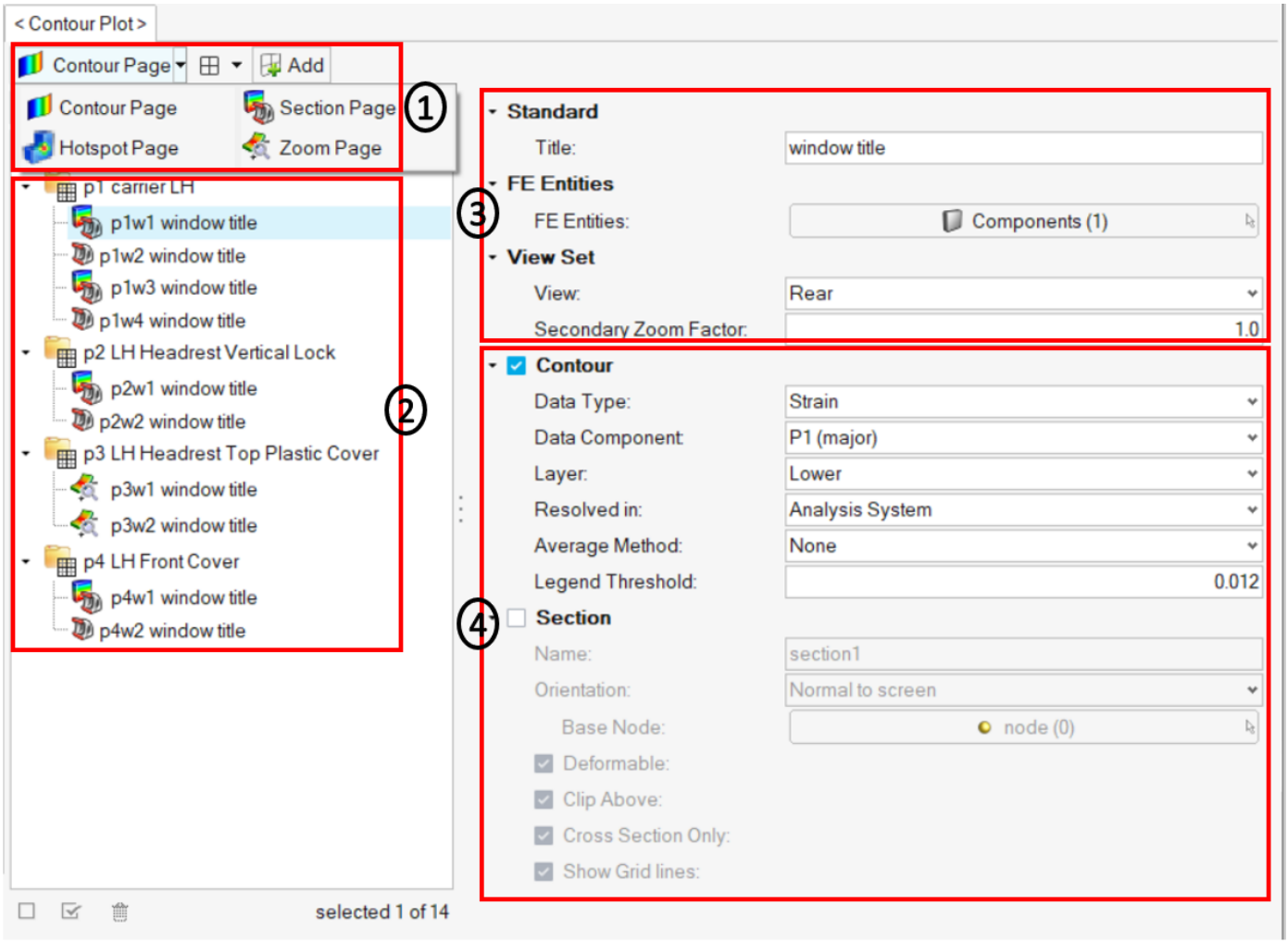


Contour Plot

This is a generic module that allows users to define 4 different types of pages and layouts (namely **Contour** page, **Section** page, **Hotspot** Page & **Zoom** page) and include them in the report. It has the following capability.

- Ability to generate reports with any scalar result datatype contour.
- Ability to find Hotspots & report them.
- Ability to draw section cuts.
- Ability to capture images with user specified zoom factor.

The GUI and the various inputs that are required to be defined are mentioned below.



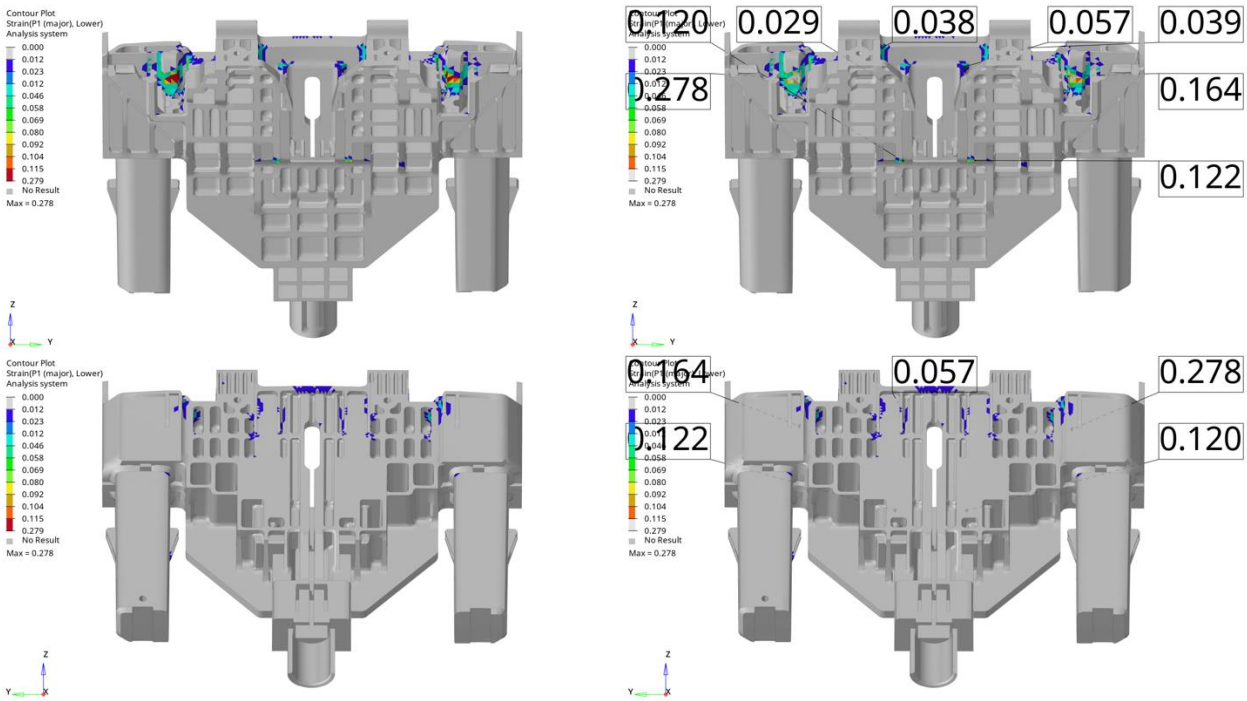
Inputs:

1) Use this input to select the page & window layout that will be captured and included in the report. The layouts supported are different for different page types as mentioned below.
    a. Contour page – 1 x 1, 1 x 2 & 2 x 2
    b. Section page – 1 x 2 & 2 x 2
    c. Hotspot page – 1 x 1
    d. Zoom page - 1 x 2 & 2 x 2.

    Select the required layout and click on **Add** button to add the page layout into the entity list browser.

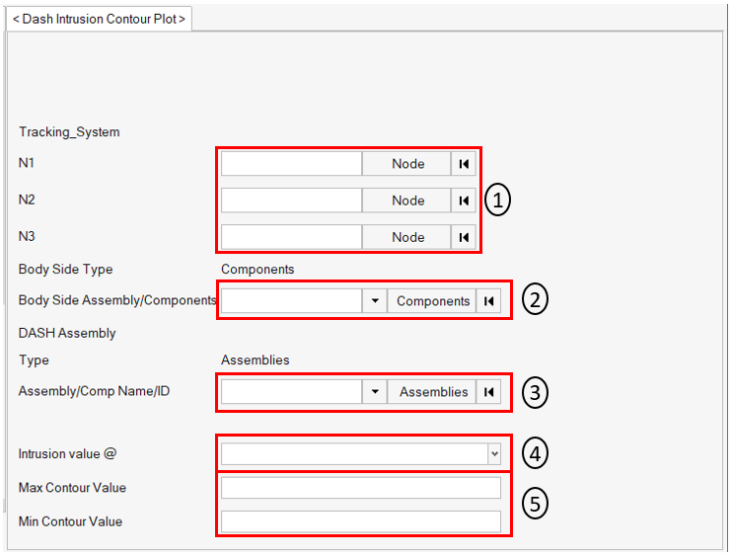
2) The **Entity** list browser is used to list and manage the pages included by the user and their respective layouts.
3) Enter the **Title** used for the slide title in the report, select the **Components** to be used for the current page type selected and the **View Set** to be used to orient the components.
4) Define the **Contour** & **Section** details (& all its attributes) to be applied while generating the report for the Contour module.

Output: Section page with 2 x 2 layout



Dash Intrusion Contour Plot

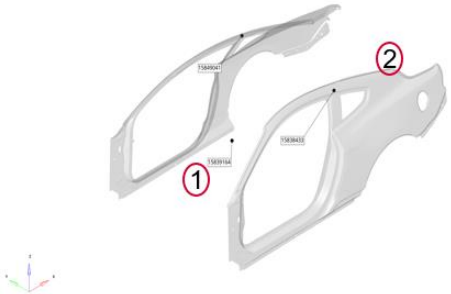
This module generates an overview of Dash Intrusion. Based on the inputs entered, it applies X displacement contour (relative to a fixed coordinate system) on the DASH assembly and finds the node ID with the max intrusion.

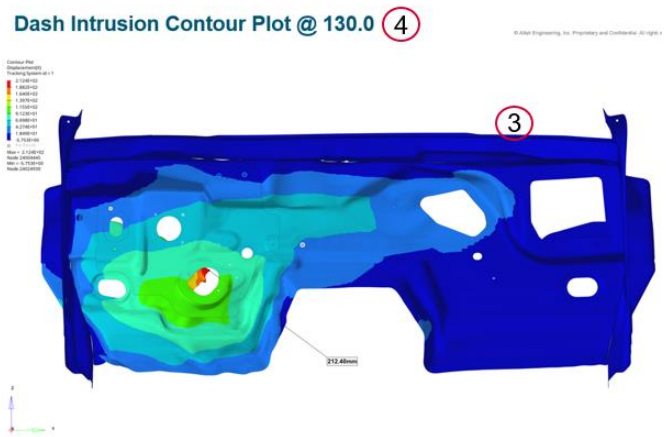


Inputs:

1) Node IDs 1, 2 & 3 for defining the tracking system
2) Body side assembly IDs used to capture the tracking system nodes
3) DASH assembly ID required for plotting Dash Intrusion contour plot
4) The step at which intrusion value is calculated. It is either the last step or the step at which max intrusion happens.
5) The minimum & maximum threshold value to be used when applying the displacement contour

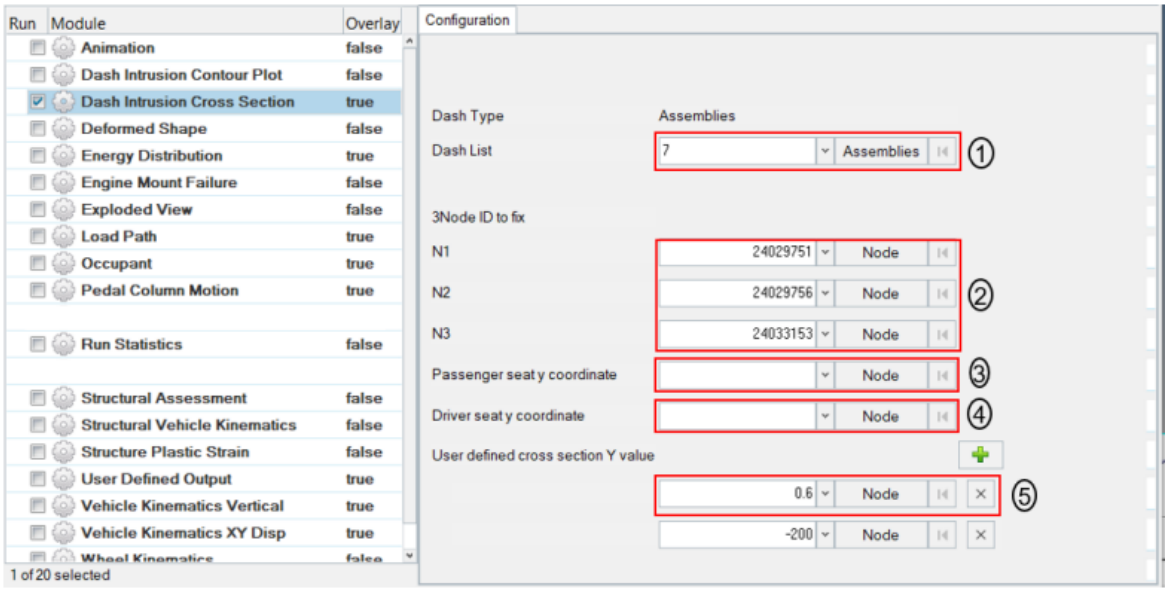
Output report:





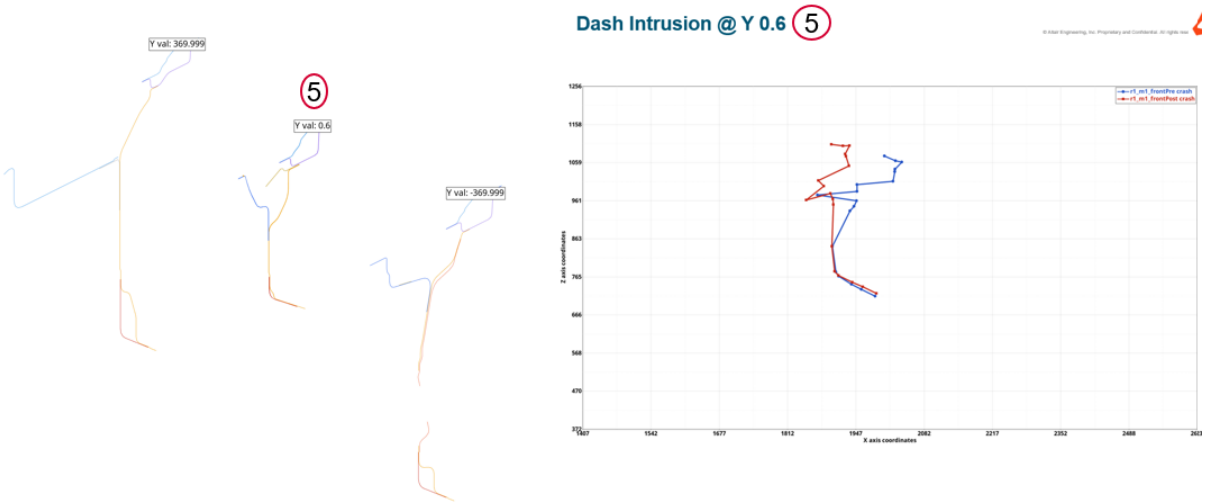
Dash Intrusion Cross Section

This module lets you create Dash Intrusion Cross sections. It will create cross sections (Pre crash & Post crash) at various user defined positions.



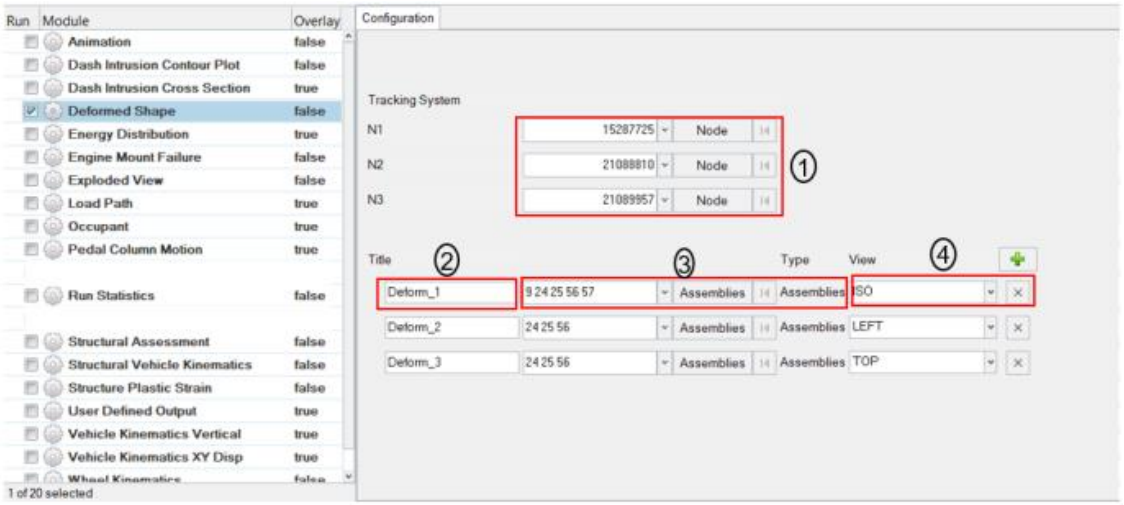
Inputs:

1) DASH assembly ID
2) Node ID 1, 2 & 3 for defining tracking system
3) Passenger seat Y coordinate (optional)
4) Driver seat Y coordinate (optional)
5) User defined cross section locations (Y value) at which the sections are cut



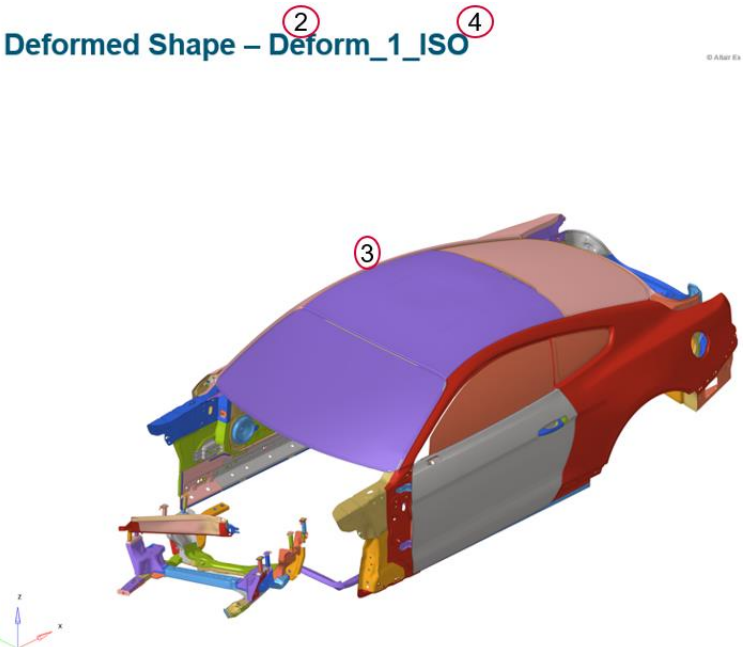
Deformed Shape

This module is used to create deformed shape of the user selected part sets (components or assemblies) in standard views (Left, Right, Top, Bottom, Front, Rear & Isometric views)



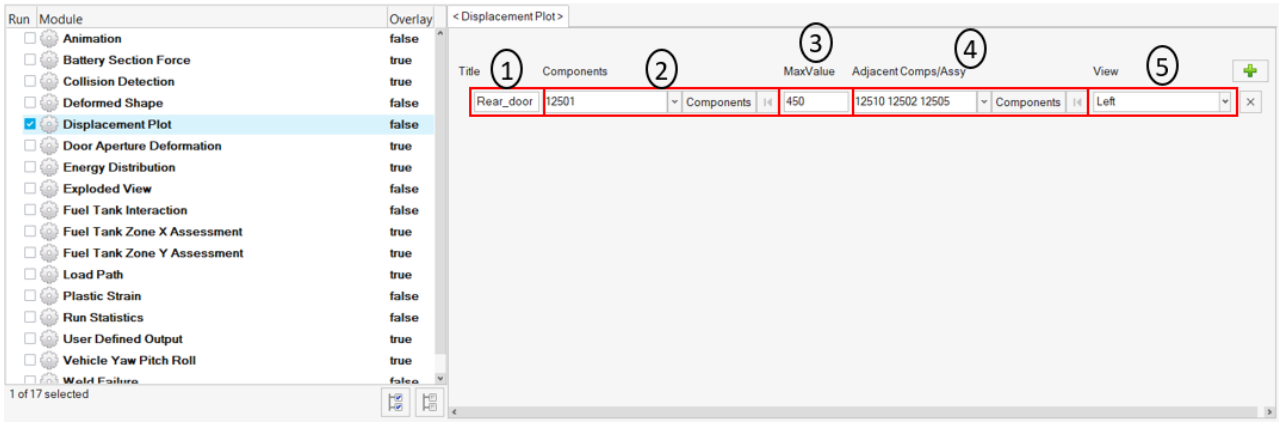
Inputs:

1) Node ID 1, 2 & 3 for defining tracking system
2) Label to be used for the slide title
3) Assembly IDs that will be considered for deformed shape
4) The view to be used for deformed shape image capture



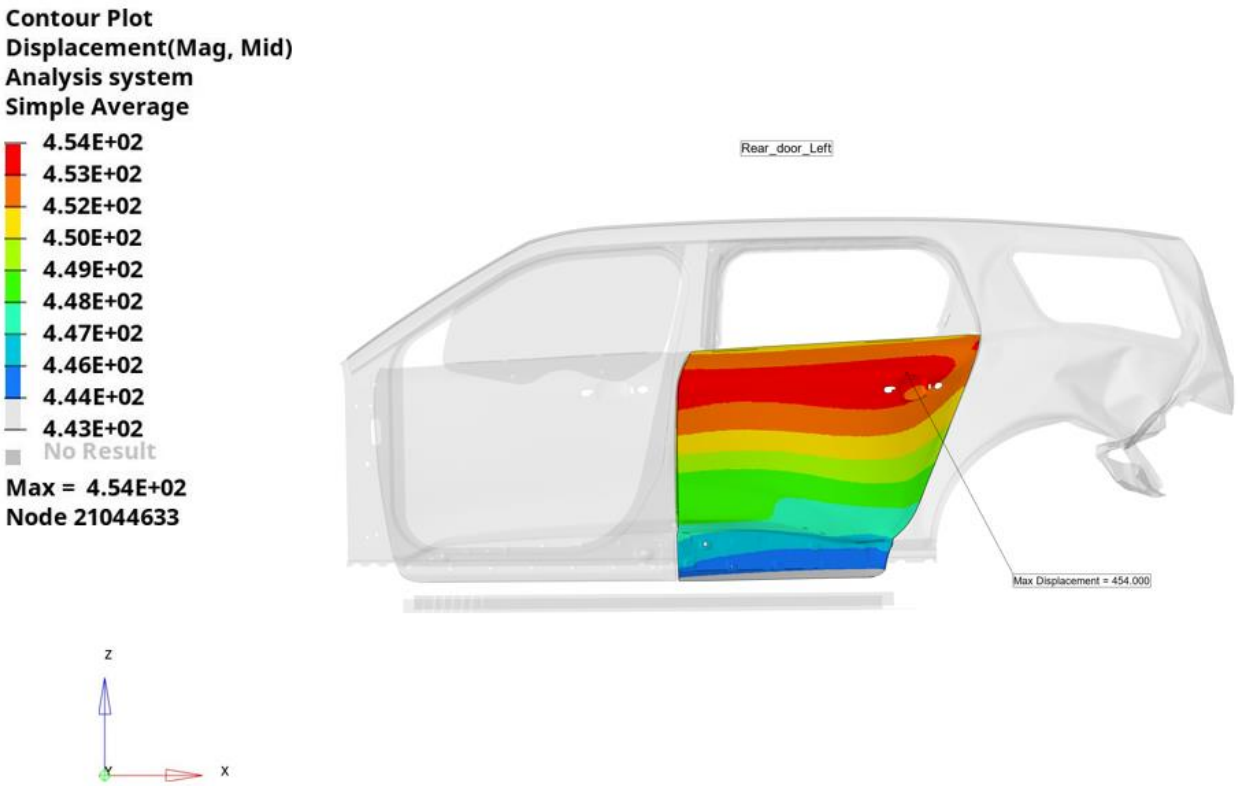
Displacement Plot

This module is used to generate a summary report of displacement contour for the user selected components.



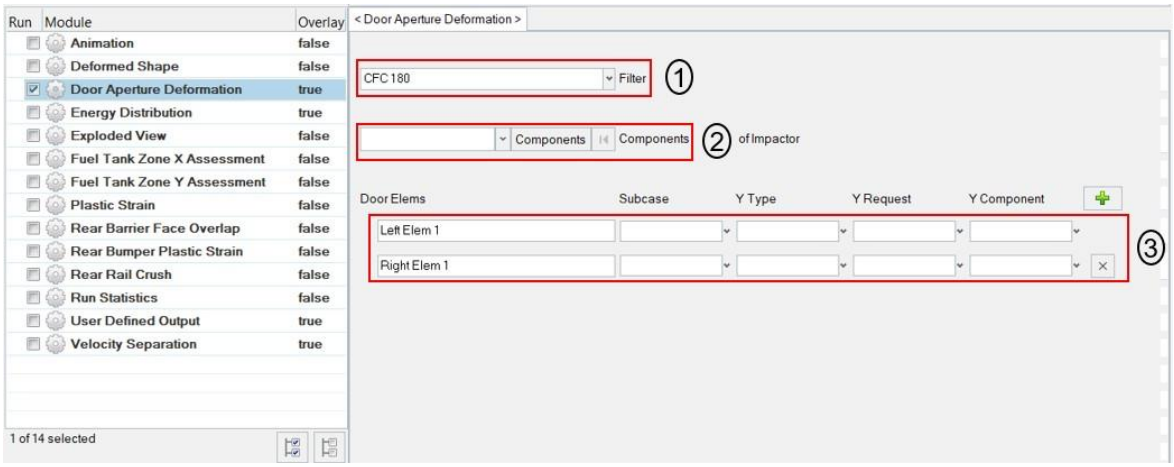
Inputs:

1) The component label
2) The component IDs used for creating displacement contour plots
3) The displacement upper limit that is set when applying the contour
4) The adjacent (or neighboring) components to be included in the image (transparent mode)
5) The standard view that should be set when capturing the image



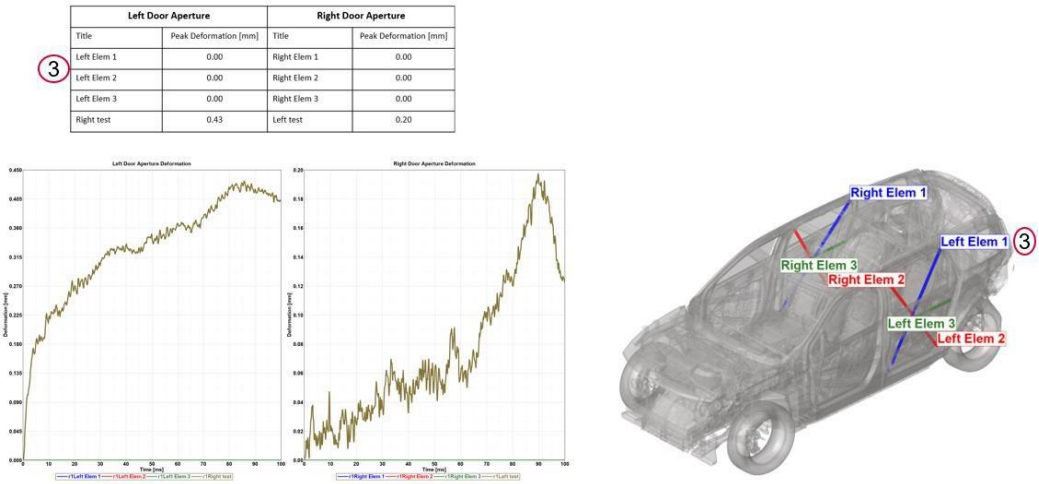
Door Aperture Deformation

This module is used to record the maximum door deformation using spring elements.



Inputs:

1) Filter class if required to filter the deformation curve
2) Impactor assembly or component ID which will be hidden from the image
3) The left & right door spring element request info (from time history file) for plotting the deformation curves

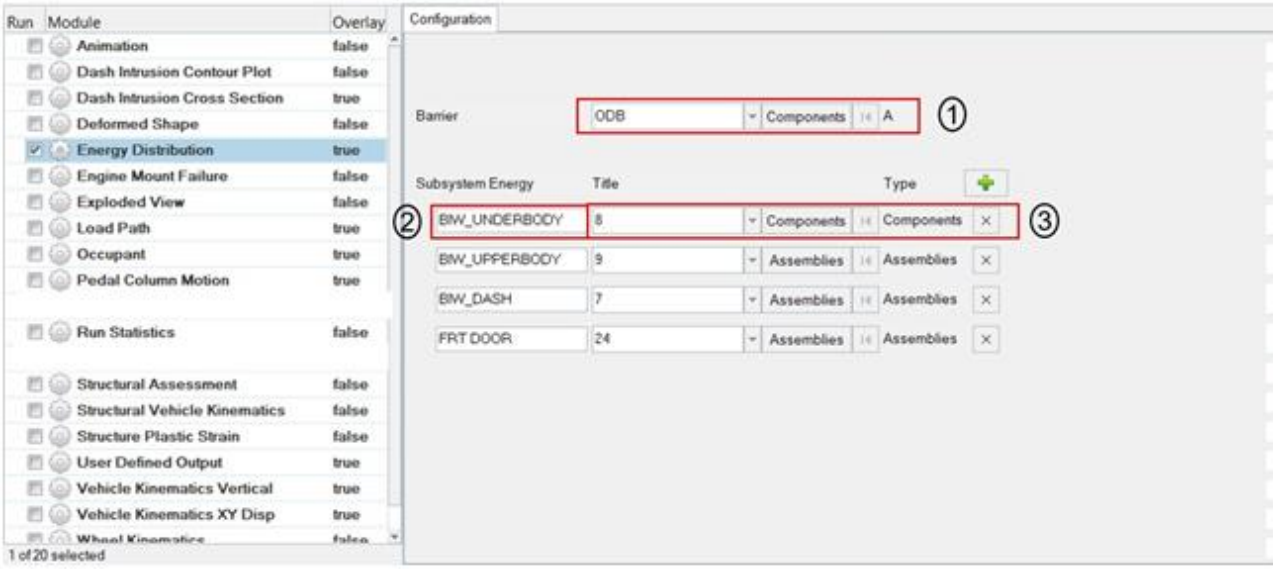


Energy Distribution

The Energy Distribution module is used to create energy distribution plots (bar graphs) for the barrier (system level) as well as for user selected sub systems such as BIW-upperbody, BIW-underbody etc.

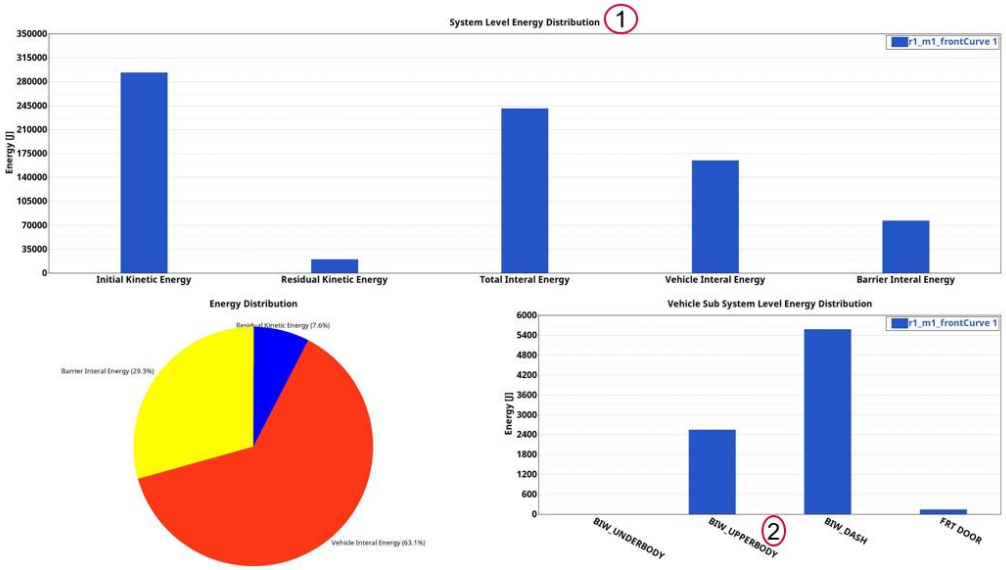
For the barrier, energy plots are created for Initial kinetic energy, residual kinetic energy, total internal energy, vehicle internal energy and barrier internal energy.

A pie chart is also created showing energy distribution for residual kinetic energy along with vehicle & barrier internal energy.



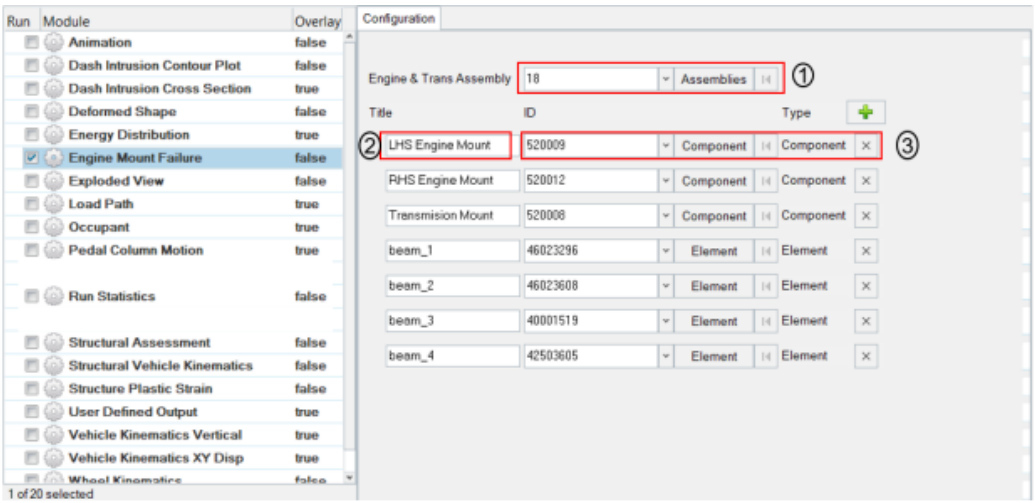
Inputs:

1) Barrier assembly or component ID
2) Subsystem name
3) Subsystem assembly or component ID



Engine Mount Failure

This module checks whether the user defined engine mount parts fracture or remain intact during the crash simulation. For the fractured parts, it finds the time at which they fracture and captures an image which highlights the time at which part separation happens.



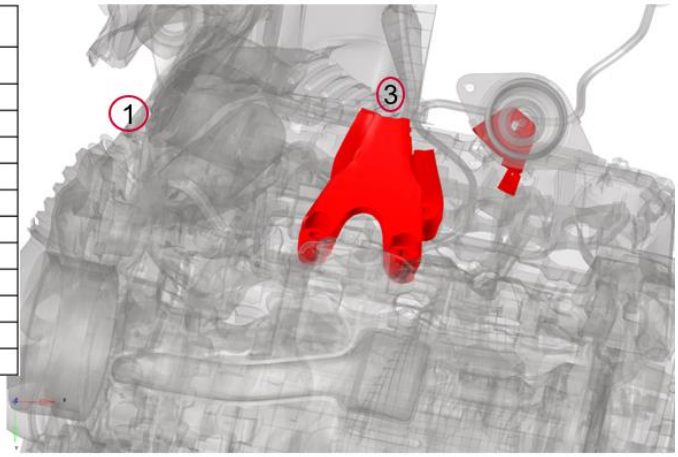
Inputs:

1) Engine assembly or component ID
2) Label for the engine mount part
3) Engine mount part ID

LHS Engine Mount (ID: 520009)

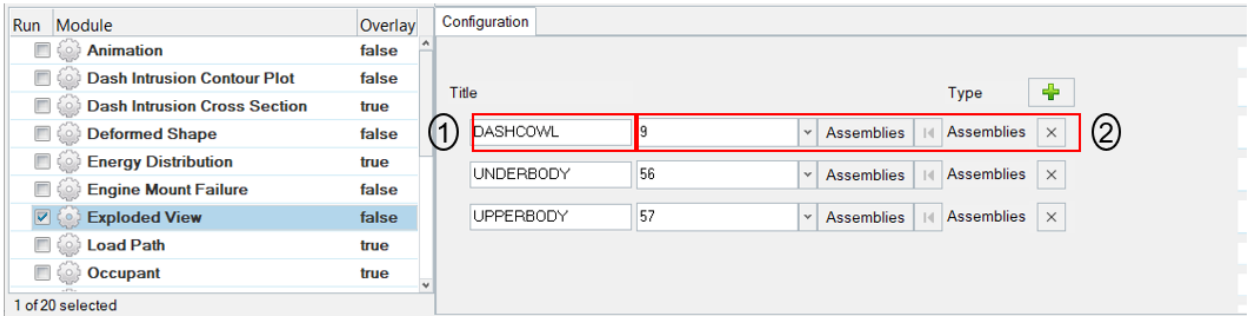
Separation time	55.0

Title	Comp/Beam	ID	Separation Time
LHS Engine Mount (2)	Solid	520009	55.0
RHS Engine Mount	Solid	520012	Intact
Transmision Mount	Solid	520008	90.0
beam_1	Beam ID	46023296	5.0
beam_2	Beam ID	46023608	5.0
beam_3	Beam ID	40001519	10.0
beam_4	Beam ID	42503605	15.0
beam_5	Beam ID	42514010	55.0
beam_6	Beam ID	52006509	75.0
beam_7	Beam ID	14110721	80.0
beam_8	Beam ID	14110739	80.0
beam_9	Beam ID	40002216	80.0



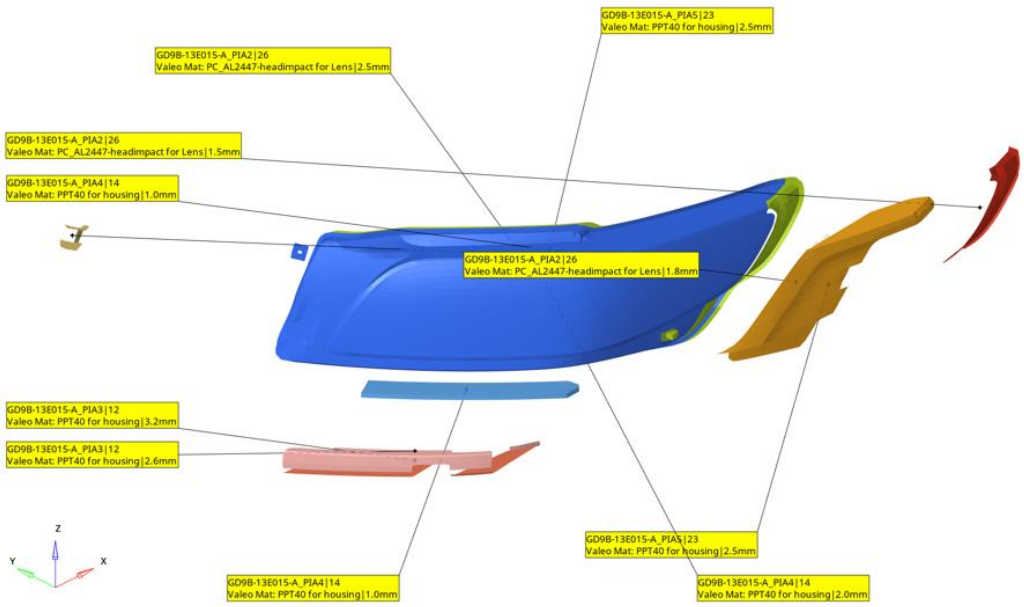
Exploded View

Exploded view lets you create images of parts in exploded view. For each user selected assembly, the parts are isolated (10 parts per slide) and exploded view is drawn and image is captured. Each part in exploded view is tagged with an annotation. It contains the part name, the material name and the assigned thickness.



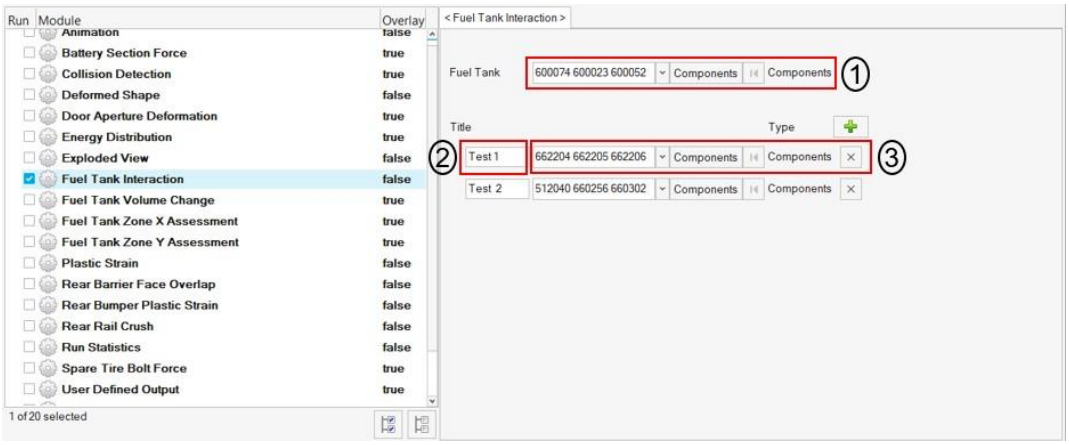
Inputs:

1) Title for the assembly that is considered for exploded view
2) Assembly or Component ID used for exploded view



Fuel Tank Interaction

This module is used to perform collision interference checking between the fuel tank assembly and the parts around it. The inputs are fuel tank assembly and the surrounding parts which might collide or meet with the fuel tank assembly during the simulation. The module will check and find out if penetration exists between the two groups. Accordingly, the components are colored, and an animation file (avi) is captured and embedded into the PPT. Users can define multiple parts.



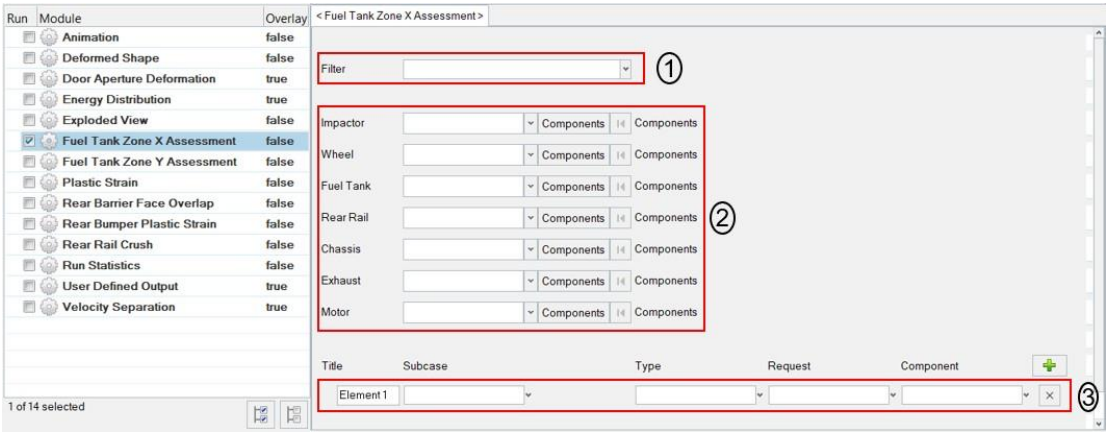
Inputs:

1) Select the fuel tank assembly (components or assembly)
2) Enter a title that is used as slide title in the PPT report
3) Select the components (assemblies) that might come in contact with the fuel tank assembly

Output report:

Fuel Tank Zone X Assessment

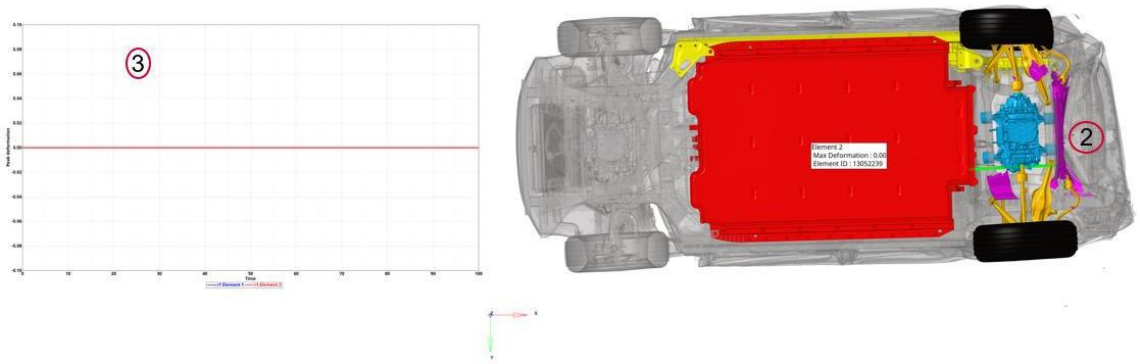
This module is used to evaluate the deformation of fuel tank zone spring elements. It computes the deformation between fuel tank zone cross members along X direction by measuring the spring element deformations.



Inputs:

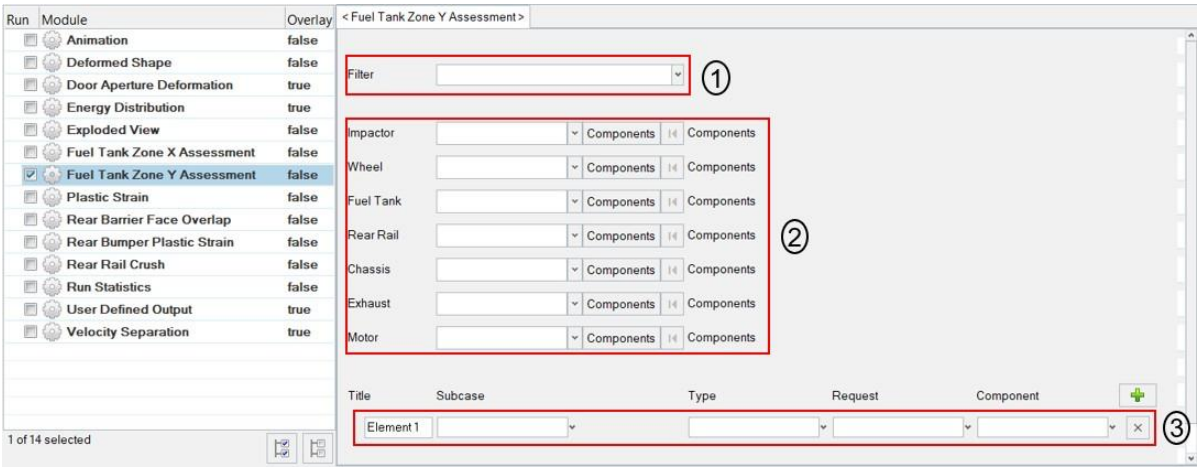
1) Filter class to be used if required to filter the deformation curve
2) Fuel tank zone cross members comp ID / Assy ID
3) The spring element request info (from time history file) for plotting the deformation curves

Fuel Tank Zone X Assessment	
Title	Peak Deformation
Element 1	0.00
Element 2	0.00



Fuel Tank Zone Y Assessment

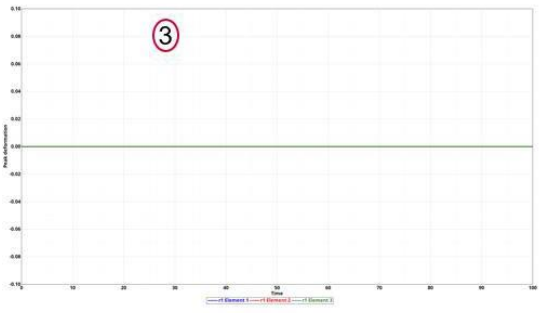
This module is used to evaluate the deformation of fuel tank zone spring elements. It computesthe deformation between fuel tank zone cross members along Y direction by measuring the spring element deformations.

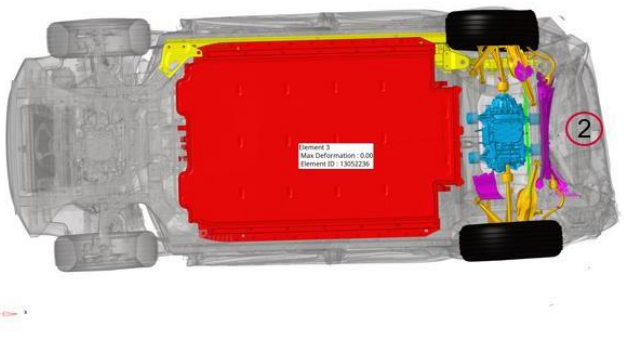


Inputs:

1) Filter class to be used if required to filter the deformation curve
2) Fuel tank zone cross members comp ID / Assy ID
3) The spring element request info (from time history file) for plotting the deformation curves

Fuel Tank Zone Y Assessment	
Title	Peak Deformation
Element 1	0.00
Element 2	0.00
Element 3	0.00





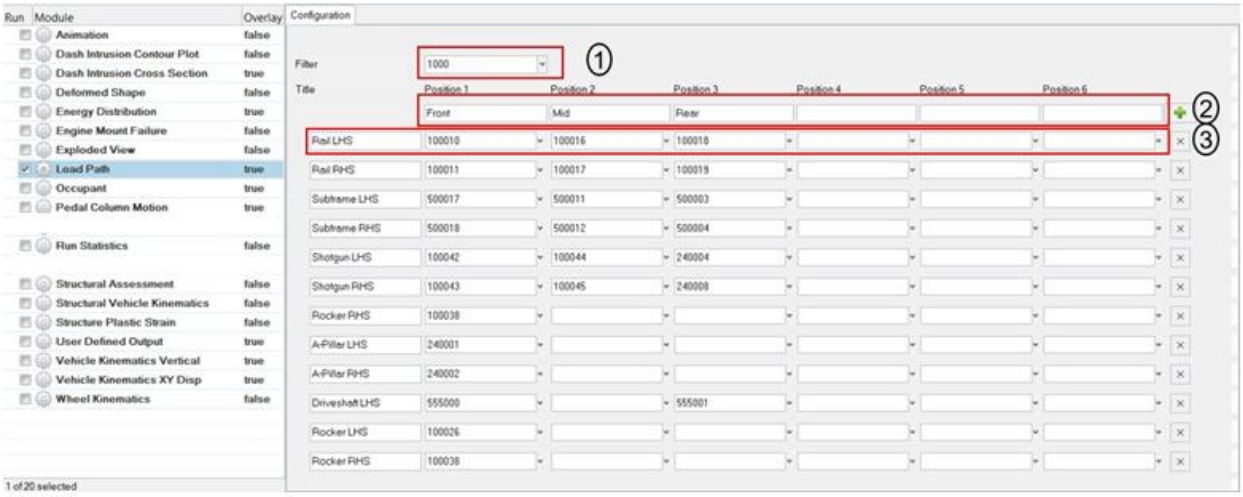
Load Path

The Load Path module lets you create following report summary.

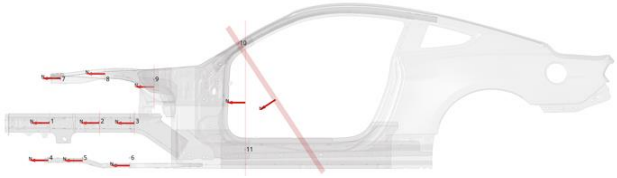
1) It creates an image of the vehicle and identifies the location of each cross section that is defined by the user in the config file

2) It creates a Load Path Section Forces and Properties summary table

3) It also creates Load Path section forces plots for all the cross sections



Cross Section Locations

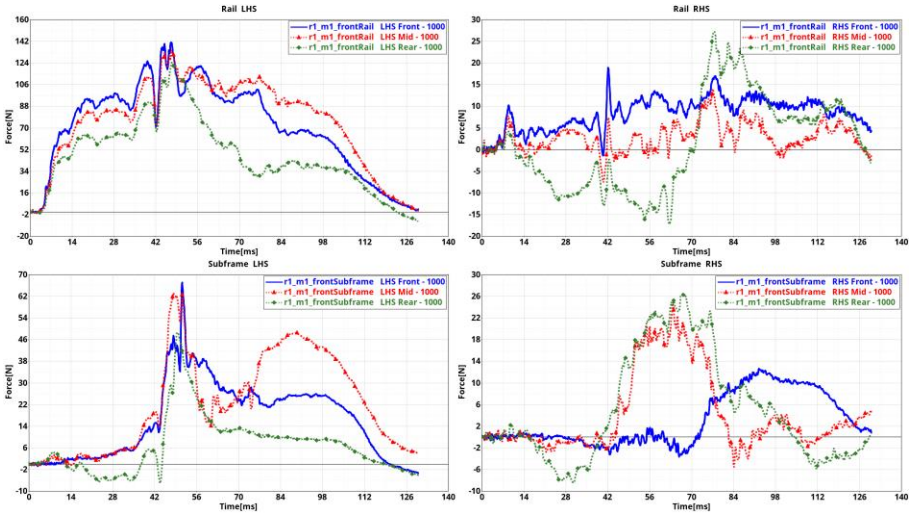


1	Rail Front
2	Rail Mid
3	Rail Rear
4	Subframe Front
5	Subframe Mid
6	Subframe Rear
7	Shotgun Front
8	Shotgun Mid
9	Shotgun Rear
10	A-Pillar Front
11	Rocker Front

Load Path Summary

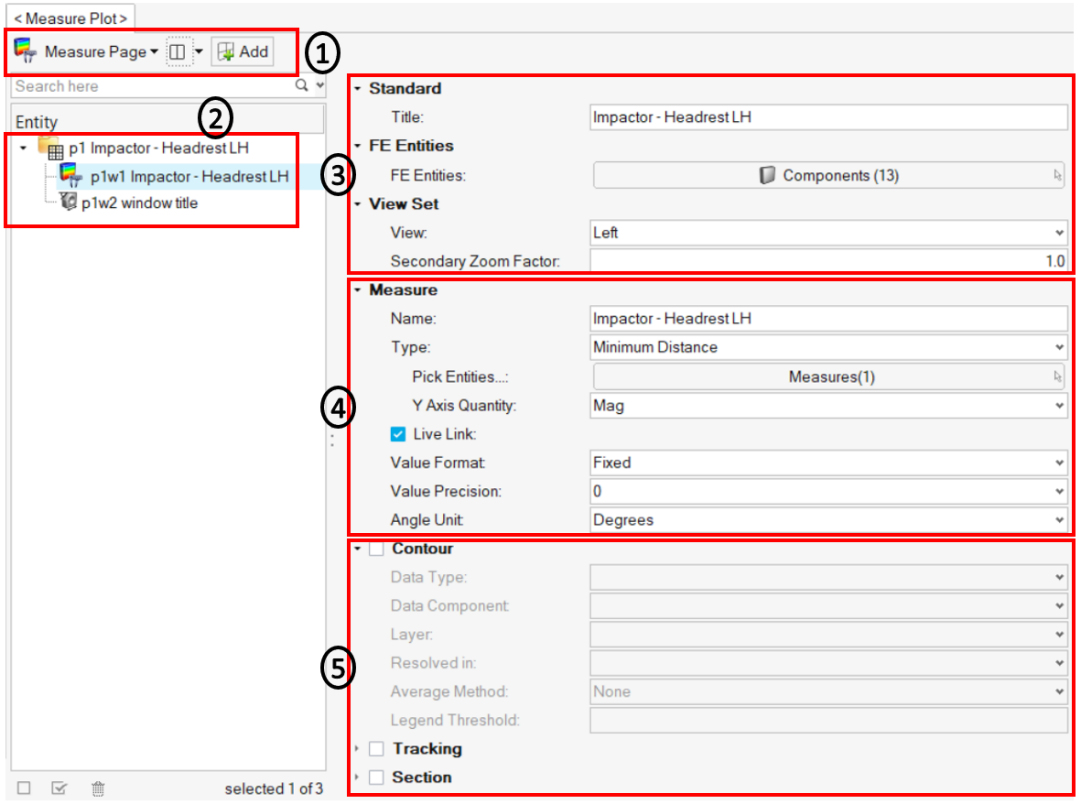
#	Title	Peak Load [LHS] (KN)	Area(mm2)	Ix (mm4)	Iy (mm4)	J (mm4)	Sx (mm3)	Sy (mm3)	Peak Load [RHS] (KN)	Area (mm2)	Ix (mm4)	Iy (mm4)	J (mm4)	Sx (mm3)	Sy (mm3)
		r1_m1_front													
1	Rail Front	141.00	38.37	178846.17	51224.93	-43216.83	847.13	693.77	18.93	38.37	165168.37	51224.92	-45234.58	847.13	693.77
2	Rail Mid	135.32	36.67	104454.26	65096.91	40738.48	792.97	679.60	14.11	36.63	63340.71	79026.63	17641.33	791.38	681.85
3	Rail Rear	125.37	39.52	124027.32	71430.19	-43017.08	880.11	776.17	27.44	39.52	184206.11	55540.15	-48580.74	880.11	776.17
4	Subframe Front	67.17	17.45	3589.02	8405.00	0.00	214.27	280.17	12.62	17.45	3589.02	8405.00	0.00	214.27	280.17
5	Subframe Mid	63.52	17.81	4033.52	8729.89	-0.58	228.13	290.98	24.74	17.81	4033.10	8729.89	0.54	228.20	290.98
6	Subframe Rear	49.07	17.45	3589.01	8405.06	0.00	214.27	280.17	26.45	17.45	3589.01	8405.06	0.00	214.27	280.17
7	Shotgun Front	23.95	64.34	74444.15	272987.83	-22519.68	699.06	1554.85	4.45	64.34	59385.91	278937.03	-34549.85	699.07	1554.85
8	Shotgun Mid	21.84	38.94	34520.59	143438.48	7054.20	791.54	961.01	20.31	38.94	47275.78	121756.20	39462.78	791.55	961.32
9	Shotgun Rear	31.99	131.04	2977343.36	4236128.96	3173750.07	4893.40	2722.56	35.47	136.25	2157098.05	1226453.29	-446369.53	3312.09	4441.09
10	Rocker Front	115.19	120.65	8934548.12	336710.24	-176468.24	12426.70	3454.34	17.31	120.65	9795451.07	904324.39	999808.24	12426.70	3454.34

Cross Section Force Plot



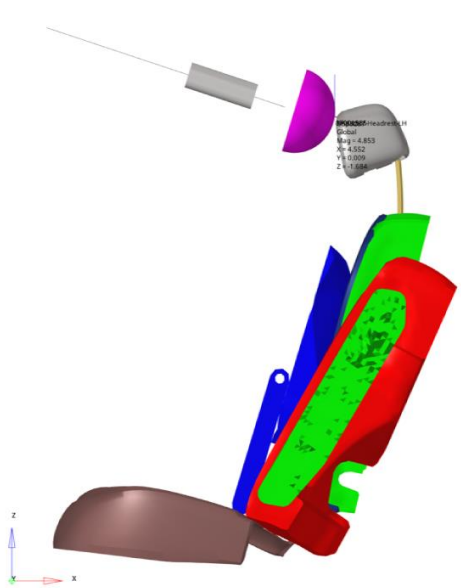
Measure Plot

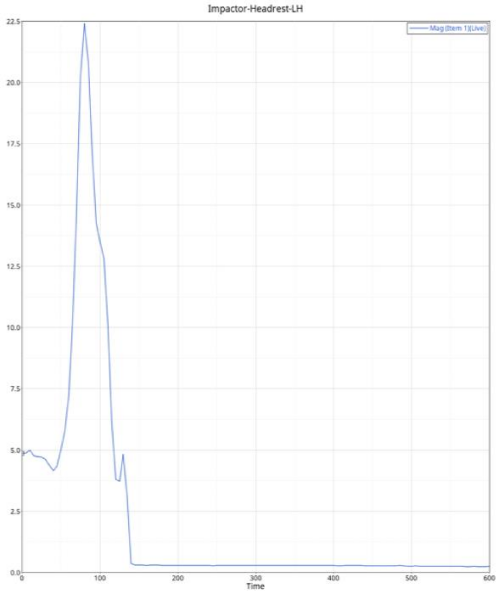
This is a generic module that allows users to apply various types of measures on the 3D animation results data, generate animations and measure plots and include them in the report. The GUI and the various inputs that are required to be defined are mentioned below.



Inputs:

1) Use this input to select the page & window layout that will be captured and included in the report. 2 layouts are supported i.e. 1 x 2 and 2 x 2. Select the layout and click on **Add** button to add the page layout into the entity list browser.
2) The **Entity** list browser is used to list and manage the pages included by the user and their respective layouts.
3) Enter the **Title** used for the slide title in the report, select the **Components** to be used for the current measure and the **View Set** to be used to orient the components.
4) Define the **Measure** and all of its attributes to be applied such as measure type, measure entities, format & precision for the measure etc.
5) Optionally user can also enter the **Contour**, **Tracking** & **Section** details to be applied while generating the report for the Measure module.



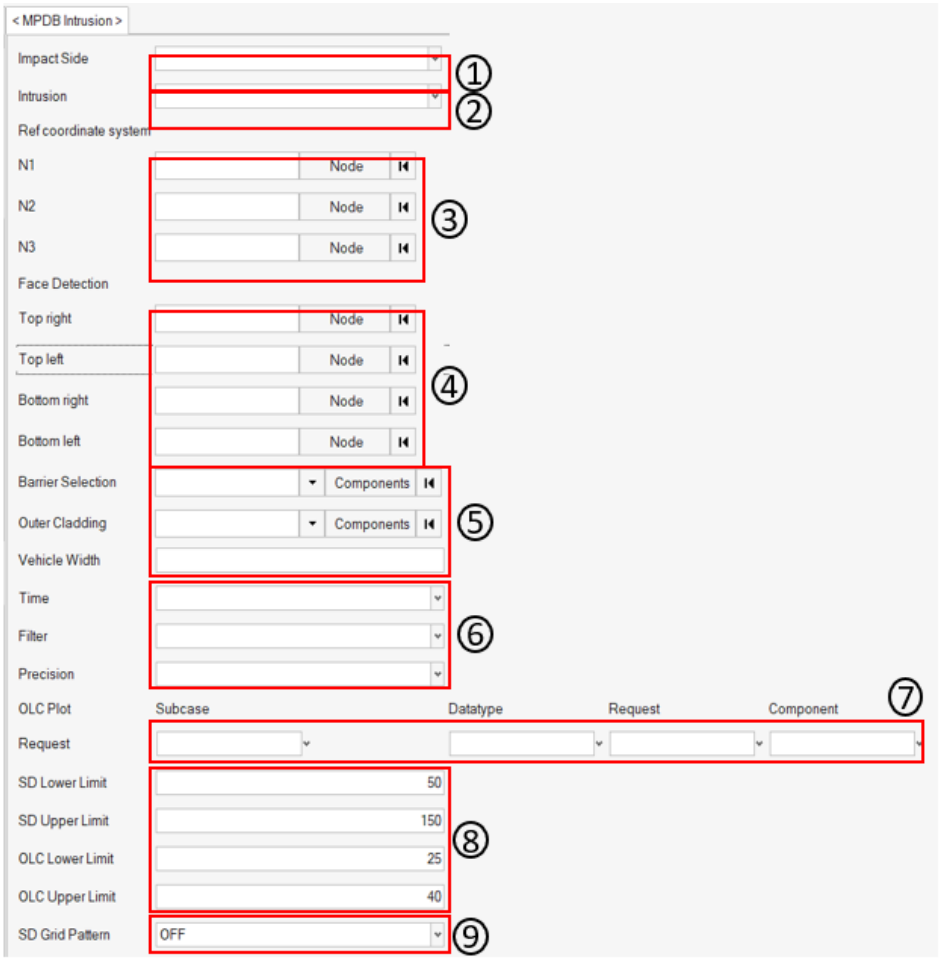

Impactor-Headrest-LH
Mag (Item 1)(Live)
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
100
200
300
400
500
600
Time

MPDB Intrusion

This module offers a complete automated post processing solution of the MPDB Frontal Compatibility Assessment load case. This is done as part of the Euro NCAP offset frontal impact test procedure updated in 2020.

This new test uses a new barrier called MPDB (Mobile offset Progressive Deformable Barrier) weighting 1,400 kg (with the trolley weight) which impacts a testing vehicle at a speed of 50 km/h, a zero-degree angle, and a 50 percent overlap. A test vehicle also impacts the trolley at a speed of 50 km/h. (100 km/h approach speed). The anthropomorphic test device (ATD) in the front seats will be changed from Hybrid-III 50th percentile male to THOR (Test Device for Human Occupant Restraint) 50th percentile male.

The tool helps the user to determine the assessment area of the PDB in dependence of the vehicle dimensions and other framework conditions. It calculates the standard deviation value of the test area thereby allowing to assess the indentation homogeneity/geometry. It also has the capability to calculate and create the Occupant Load Criterion and Modifier plots



Inputs:

1) The impact side (left or right)

2) The intrusion values to be reported & contoured (node based or element based). If element-based option is selected, then nodal results are averaged

3) Reference coordinate system, which is a right-handed, three-axis orthogonal coordinate system that is used for intrusion measurements

4) The 4 corner node IDs that define the front face of the mpdb barrier

5) The barrier component IDs, the outer cladding component ID and the vehicle width to be considered for assessment area evaluation

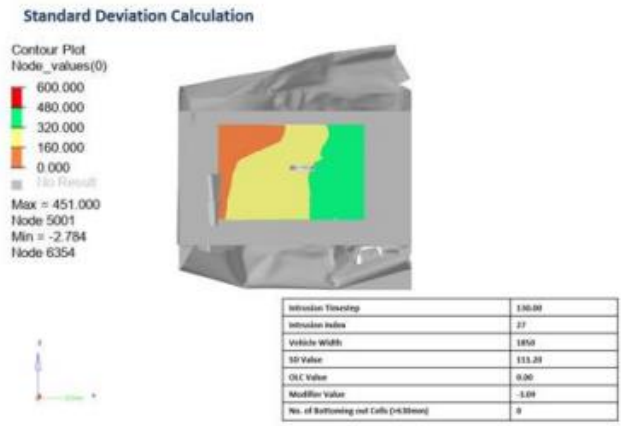
6) The time step at which the intrusions (normal projection distance from the reference plate to the barrier) are reported, the SAE filter class to be applied on the acceleration curve plotted for the above request & the precision required for OLC algorithm (0 means <= 0.1%; 1 means <= 0.001%)

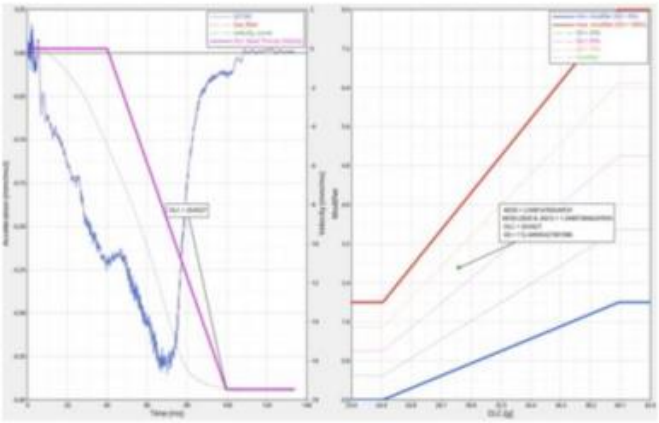
7) The subcase, datatype, request ID & the component from time history file used for OLC calculation

8) The lower & upper limits for SD & OLC parameters used in the modifier plot. This should be changed only when there is a change in regulation.

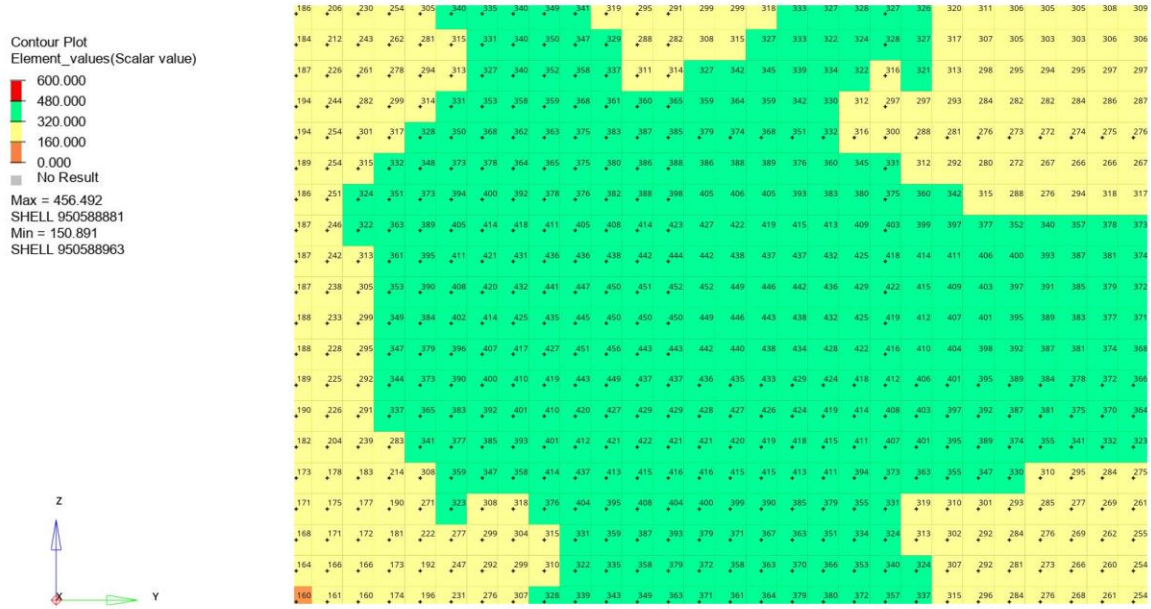
9) GRID pattern selection. This option, when turned ON displays the barrier deformation (intrusion contour) on the reference plate as a grid projection.

Outputs:





GRID projection



Occupant

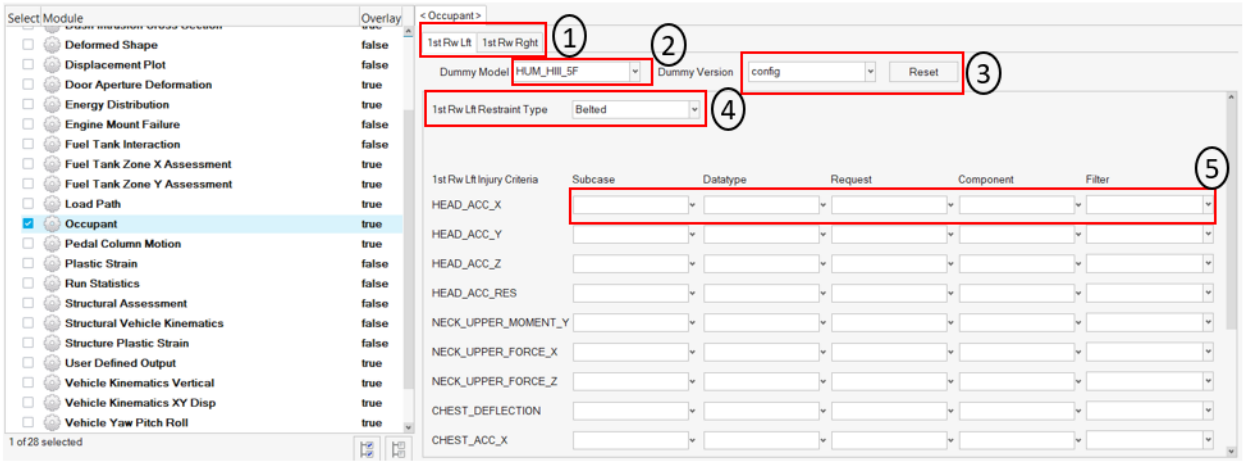
Occupant module generates following summary report based on user selected info.

1) Occupant summary table

2) Bar graphs comparing the occupant (Driver/Passenger) results against the regulation criteria

3) Occupant performance plots

The occupant GUI is designed in such a way that if offers flexibility to support various types and versions of dummies as per the supported impact and regulation types. A snapshot of the GUI is as shown below.



Inputs:

1) **Tabs** allowing users to define occupant (driver & passenger) info independently

2) **Dummy model** selection option. Currently for the Front impact type, FMVSS 208 regulation & full-frontal protocol, we support Hybrid III 5th & 50th percentile dummy types.

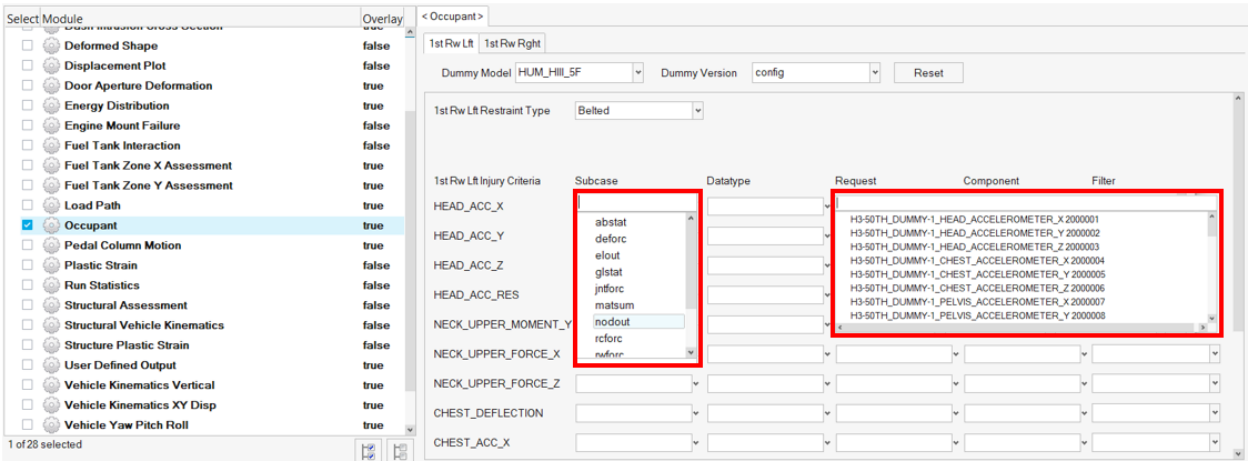
3) **Dummy version** selection. Users can either select a particular version number from the drop down or set it to config option. When selecting a version number, all the subcase, datatype, request & component types along with filters are predefined based on defaults config file. When user selects the config option then it is user's responsibility to define all the inputs. This is especially needed when using a newer dummy version.

4) **Dummy restraint type**. Currently for the FMVSS 208 regulation & full-frontal protocol, two restrain types are supported namely Belted & Unbelted.

5) **Driver / Passenger Injury Criteria selection**. This option is enabled only when the dummy version is set to config. User should first make sure to load the Time History file (binout) by clicking the **Search** button. After loading the file, user can start defining the appropriate subcase, datatype, request & component types for each of the injury criteria.

Note:

In addition to above inputs, there is **1st Rw Lft ID & 1st Rw Rght ID**. This option is enabled or used only when the dummy version is set to anything other than config. This is needed by the tool so it can differentiate between driver & passenger request IDs when plotting the occupant injury curves.

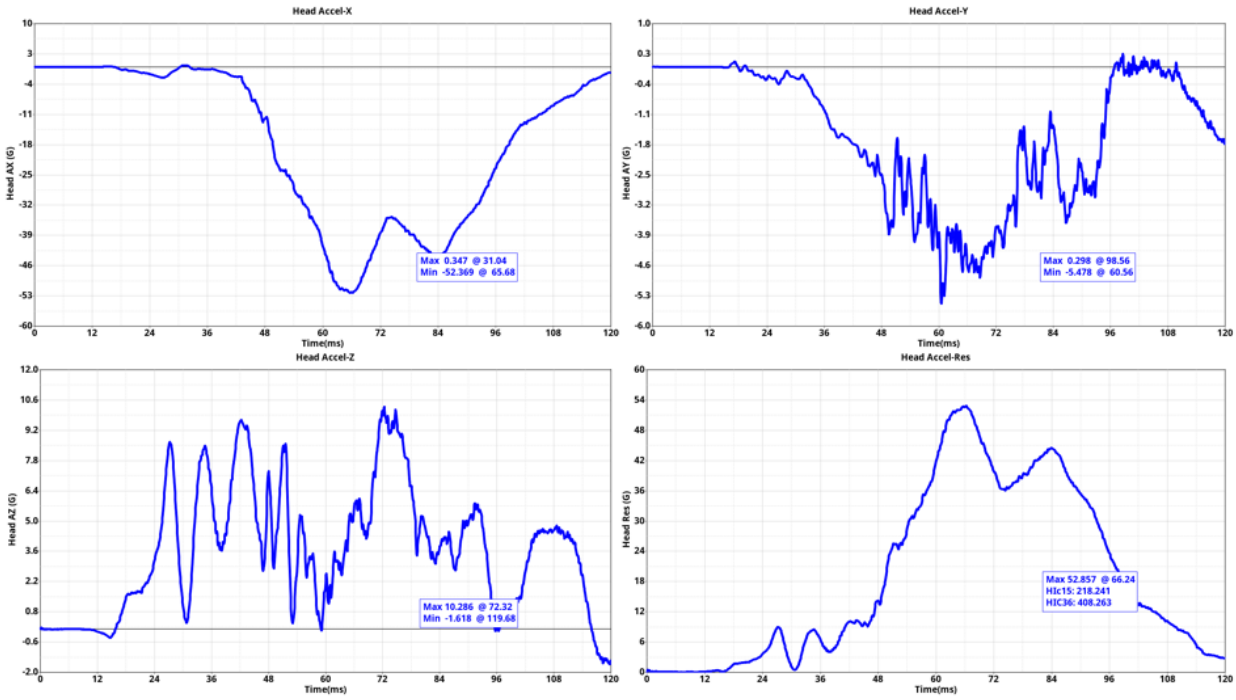


Occupant Summary

Occupant	1st Rw Lft	Internal	1st Rw Rght	Internal
Iteration	main_iter_		main_iter_	
Dummy model	HUM_HIII_5F		HUM_HIII_5F	
Restraint type	Belted		Belted	
HIC (15ms)	228.41	480	228.41	480
HIC (36ms)	427.29	-	427.29	-
Upper Neck Tension +Fz (N)	1326.03	1880	1326.03	1880
Upper Neck Compression -Fz (N)	15.12	1810	15.12	1810
NTE	0.23	0.67	0.23	0.67
NTF	0.50	0.67	0.50	0.67
NCE	0.00	0.67	0.00	0.67
NCF	0.07	0.67	0.07	0.67
Chest Cumdur (3ms) (g)	43.84	49	43.84	49
Chest Deflection (mm)	176.99	40	176.99	40
Left Femur Compression -Fz (N)	672.57	5310	672.57	5310
Right Femur Compression -Fz (N)	697.17	5310	697.17	5310

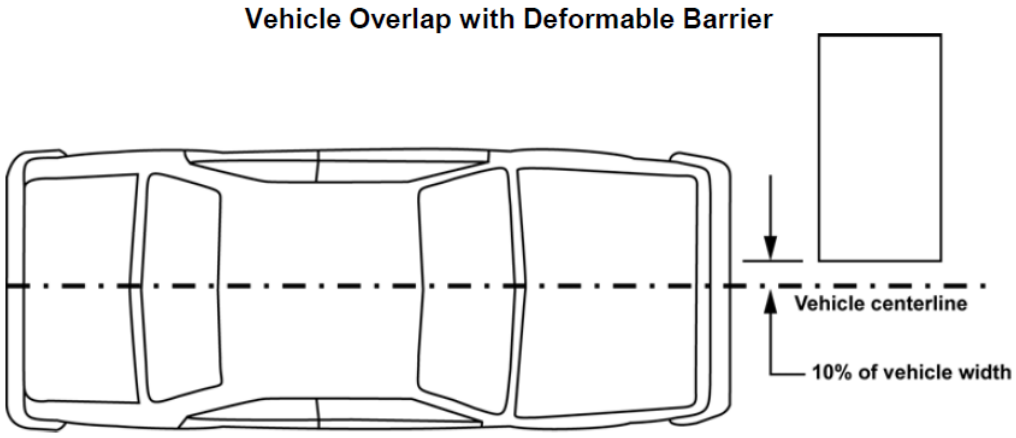
ALTAIR

Driver Head Acceleration



ODB Intrusion

This module is used to measure vehicle intrusion as per IIHS – Offset Barrier crash test protocol. The tests are conducted at 64.4±1 kph (40±0.6 mph) and 40±1 percent overlap. The test vehicle is aligned with the deformable barrier such that the right edge of the barrier face is offset to the left of the vehicle centerline by 10 ± 1% of the vehicle width as shown below.

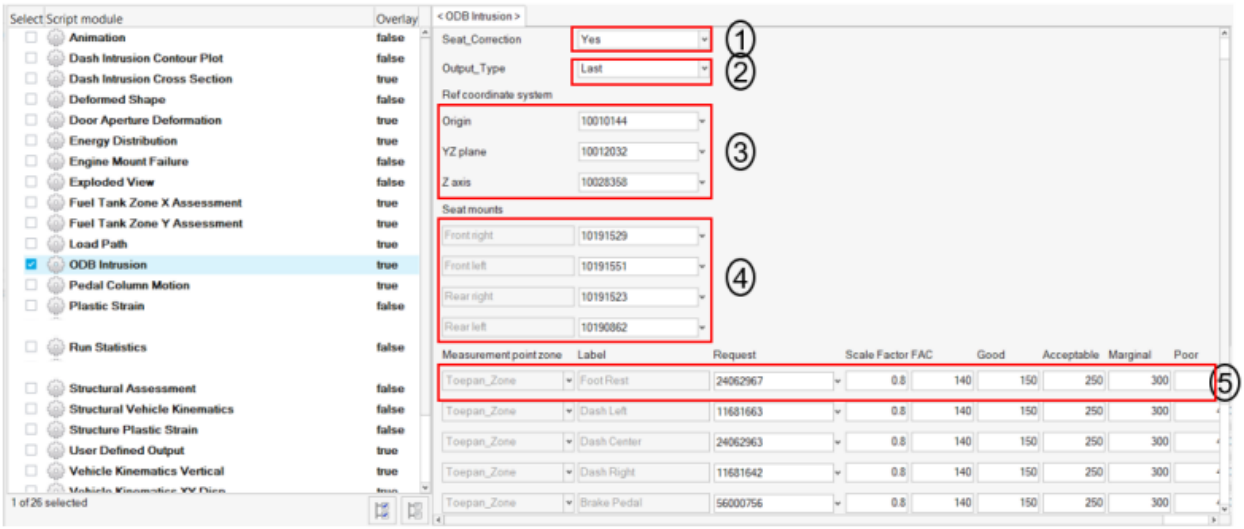


A total of 14 measurement locations are used in general (on the driver-side interior & exterior of the vehicle) and their longitudinal, lateral & vertical displacements with respect to a user defined coordinate system are measured.

The following are the locations for measuring vehicle intrusion.

Steering column (one point), lower instrument panel (two points), brake pedal (one point), toepan (three points), left footrest (one point), seat bolts (typically four points, each of the 4 bolts that anchor the driver seat to the vehicle floor), A-pillar (one point) and B-pillar (one point marked at the same vertical coordinate as the lower A-pillar mark).

In addition, user can enter the scale factor along with the criteria values. User can also enter as many additional measurement locations as needed.



Inputs:

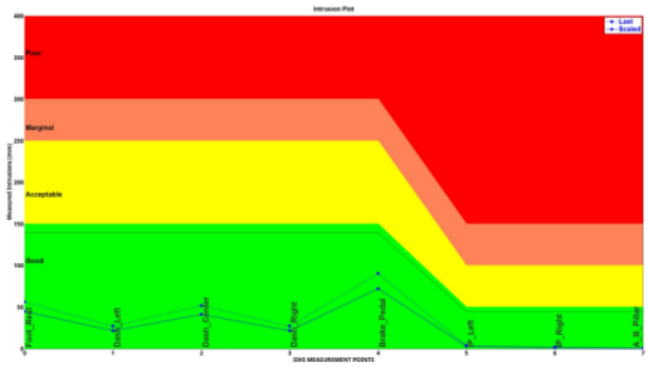
1) The seat correction option, whether seat correction should be considered or not when calculating the intrusions

2) The timestep at which intrusions should be measured (last timestep or dynamic max timestep)

3) Reference coordinate system, which is a right-handed, three-axis orthogonal coordinate system that is used for intrusion measurements

4) The request IDs for the four seat bolts (front and rear left & right locations)

5) The request IDs for all the measurement locations where intrusions will be measured



Location	Scale Factor	Intrusion (mm)	
		Last	Scaled
Foot_Rest	0.80	56	45
Dash_Left	0.80	27	22
Dash_Center	0.80	52	41
Dash_Right	0.80	27	22
Brake_Pedal	0.80	91	73
IP_Left	0.80	4	3
IP_Right	0.80	2	2
A_B_Pillar	0.80	1	0

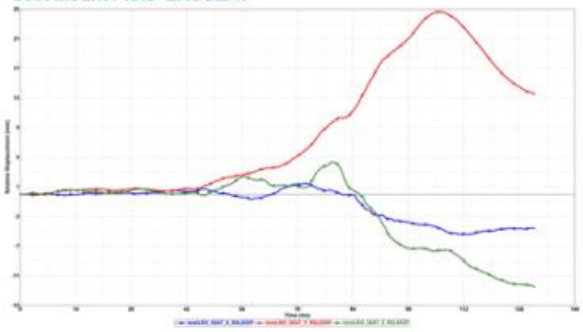
Occupant Kinematics Modifier

Seat Attachment Relative Vert. Displ. ≥ 60 mm	7.8

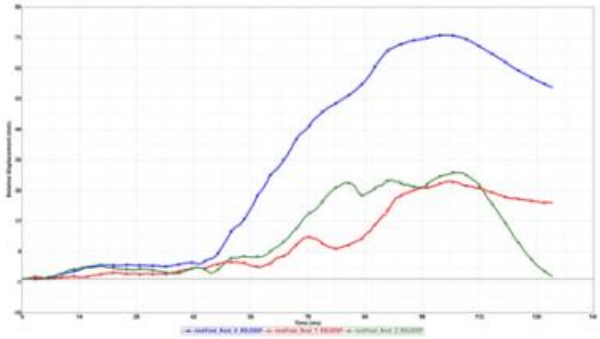
Structure Modifiers

Structural Integrity	Not Assessed
Fuel/HEV System Integrity	Not Assessed

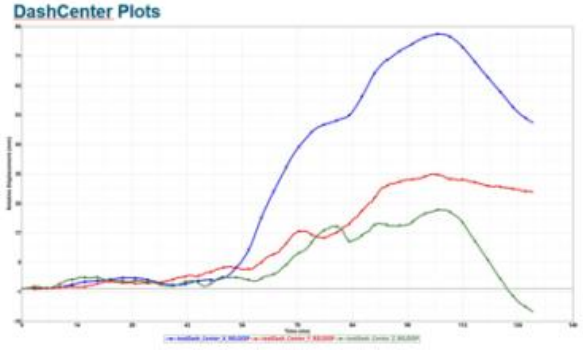
Seat Mount Plots LROSEAT



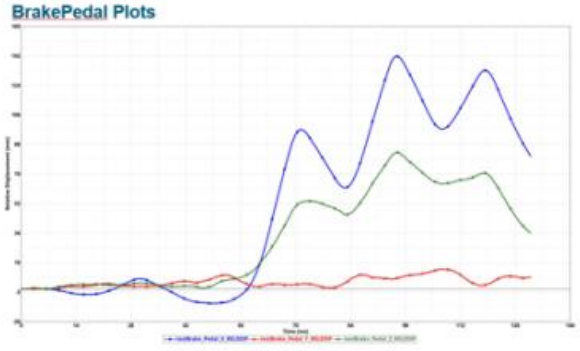
FootRest Plots



DashCenter Plots



BrakePedal Plots



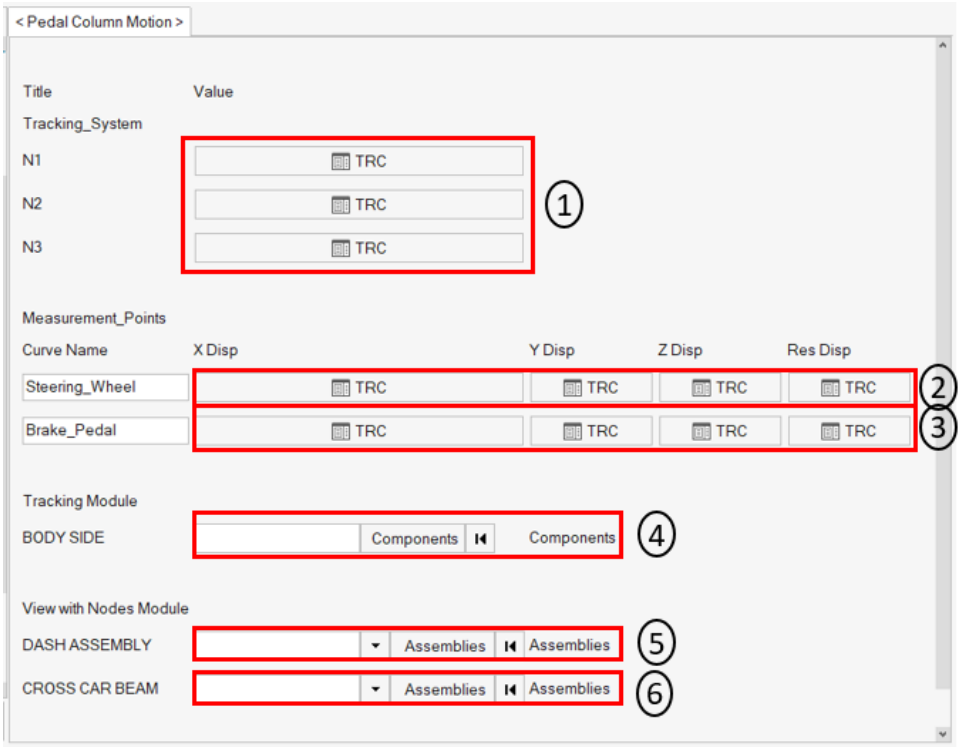
Pedal Column Motion

This module is used to generate a summary report for brake pedal and steering column.

1) A summary table capturing deflection value (X, Y, Z min & max displacement values) and time for both brake pedal & steering column

2) An image capturing the location of brake pedal & steering column parts

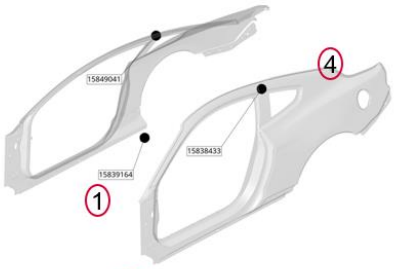
3) X, Y, Z and resultant displacement plots for both brake pedal & steering column

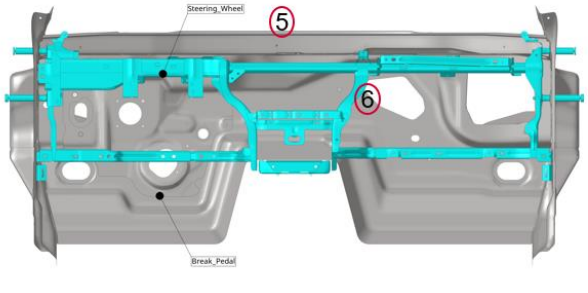


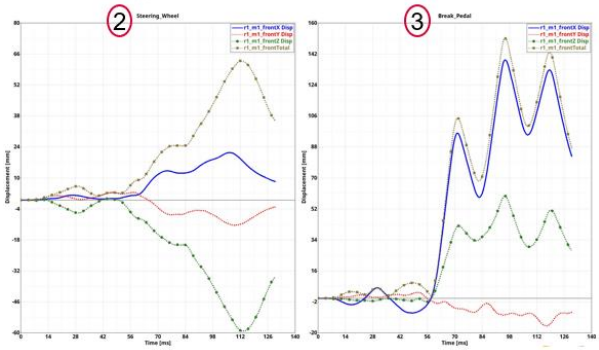
Inputs:

1) The 3 nodes N1, N2 & N3 defining tracking system
2) The steering column name and the corresponding request ID required for plotting
3) The brake pedal name & request ID required for plotting
4) The body side component IDs required for capturing tracking system nodes
5) DASH assembly ID
6) Cross car beam assembly ID

		r1_m1_front		
		Steering_Wheel		Break_Pedal
Node ID	58359757		56000756	
	Deflection [mm]	Time [ms]	Deflection [mm]	Time [ms]
X Min	-0.02	3.68	-8.47	48.32
X Max	21.44	106.64	138.52	95.76
Y Min	-11.41	109.12	-16.01	117.12
Y Max	3.46	57.76	3.45	50.72
Z Min	-59.28	113.20	-2.03	55.76
Z Max	0.69	44.96	59.55	95.60
X @ T Max	21.44	129.92	138.52	129.92
Y @ T Max	11.41	129.92	16.01	129.92
Anchor Node ID	15849041	15839164	15838433	

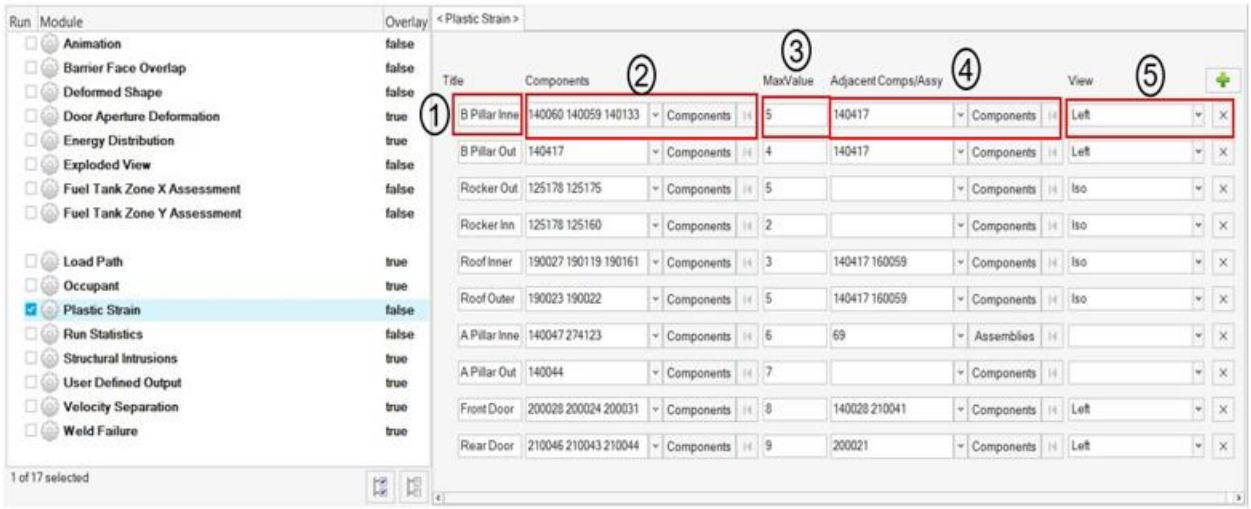






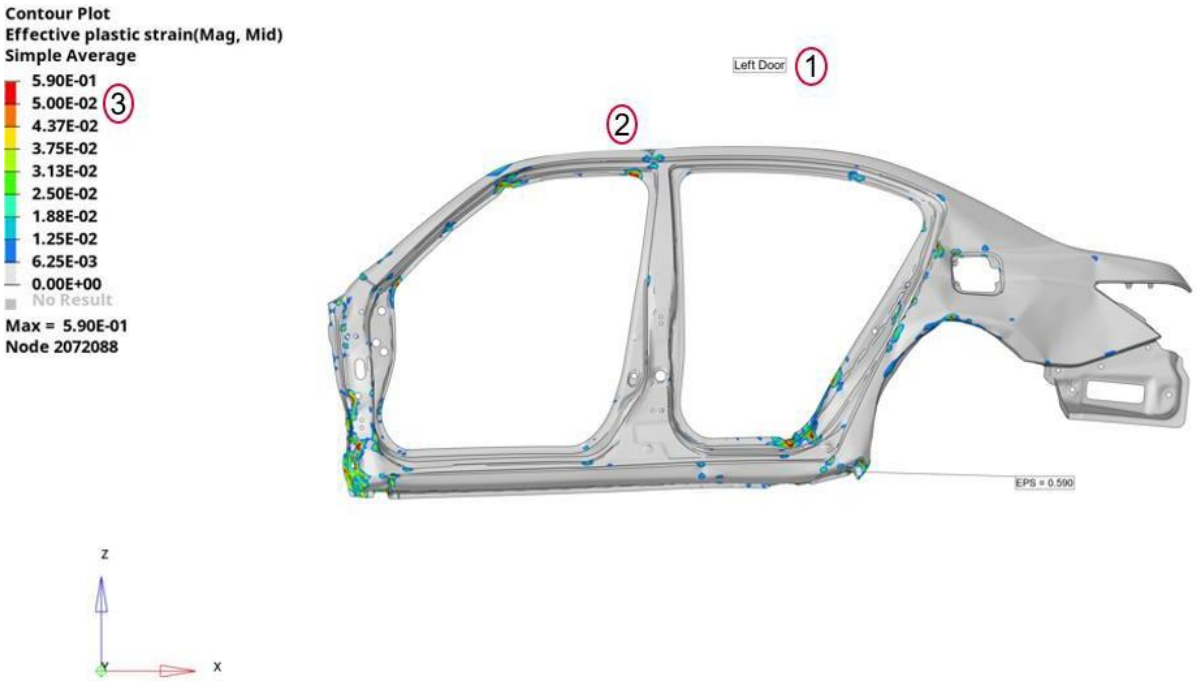
Plastic Strain

This module is used to generate a summary report of plastic strain for the components on the outer side of the vehicle structure.



Inputs:

1) The component label
2) The plastic strain component IDs to be plotted
3) The plastic strain limit that is set when applying the contour (Enter the percent value)
4) The adjacent (or neighboring) components to be included in the image (transparent mode)
5) The standard view that should be used when capturing the image



Run Statistics

This module creates following summary info.

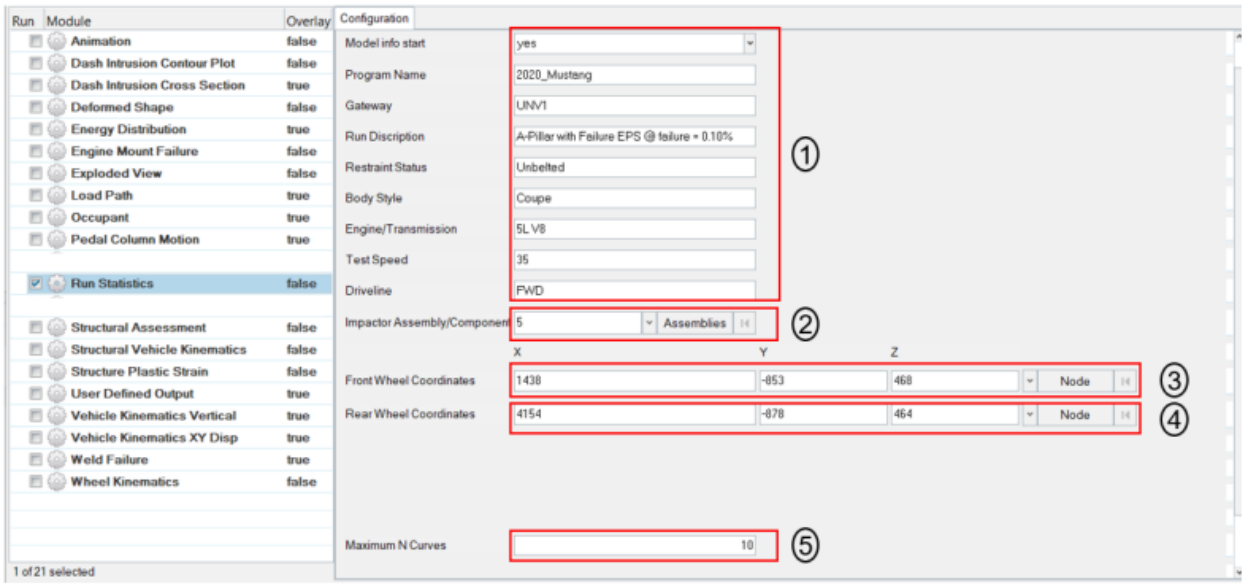
1) Model Information summary containing Program Name, Gateway, Run description, vehicle weight, solver version, run time etc.

2) Run Quality report which consists of termination time, termination type, mass added, energy ratio etc.

3) Plots consisting of global energy plots, added mass & time step plots and energy ratio plots

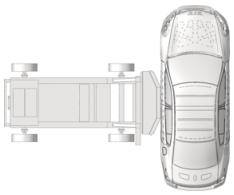
4) An image containing vehicle mass & geometric measurements

5) Material Internal Energy plots for the user defined Top N parts



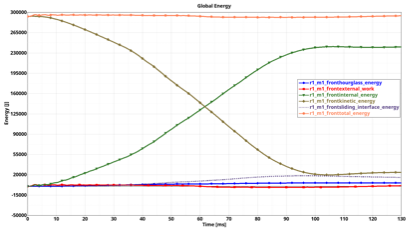
Model Info Summary & Run Quality Report

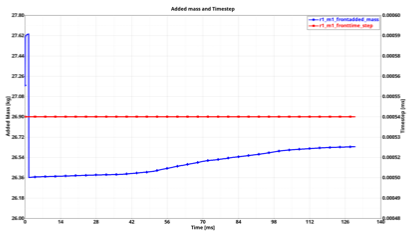
Program Name	Test
Gateway	abcd
Run Discription	Side Impact test run
Restraint Status	Belted
Body Style	Sedan
Engine/Transmission	V4
Test Speed	35 Kph
Driveline	AWD
Run Name	Main.k
Engineer	tejasr
Model Run Date	0 9 / 1 8 / 2 0 2 1
Test Mode	Side CIASI - IIHS OLD (Pre 2021) MDB
Gross Vehicle Weight	1826.09 kg
Impactor Weight	0.00 kg
Total Weight	1826.09 kg
Vehicle Front Axle Weight	1016.54 kg
Vehicle Rear Axle Weight	809.55 kg
Solver Version	mpp s R7.1.2
Number of CPU	8 CPU
Run Time	21 hr 41 min 54 sec

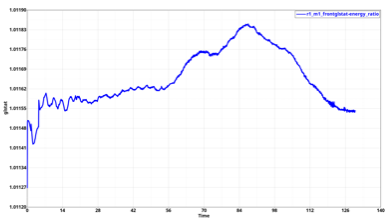


Run Quality	Result	Target
Termination Time	0.2 ms	0.2 ms
Termination Type	Normal Termination	
Mass Added @ T=0 [%]	0.44 %	< 1 %
Total Mass Added [%]	0.96 %	< 3 %
Total Mass Added [kg]	0.03 kg	
Energy -> Hourglass [%]	3.45 %	< 10 %
Energy -> Ratio [%]	1.00 %	1 >= Energy Ratio < 1.01

Global Energy, Added Mass, Time Step & Energy Ratio Plots

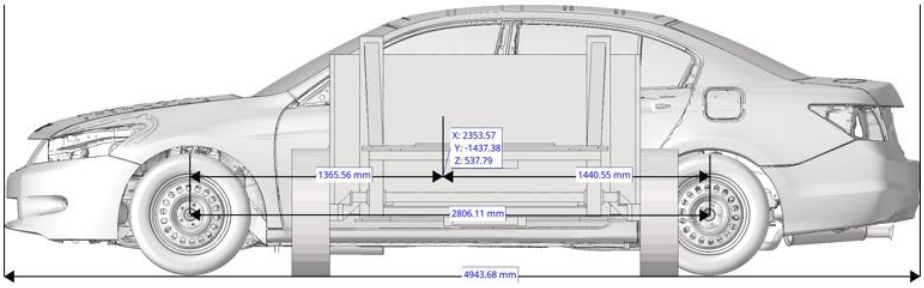




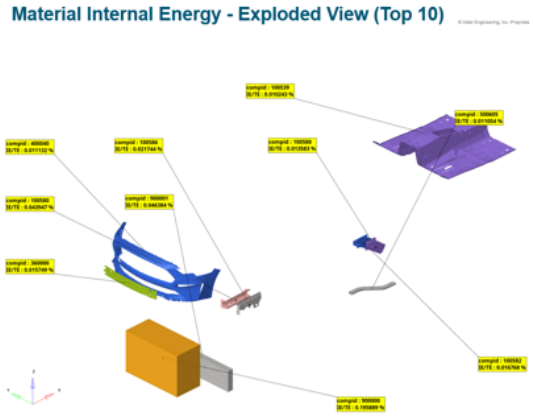


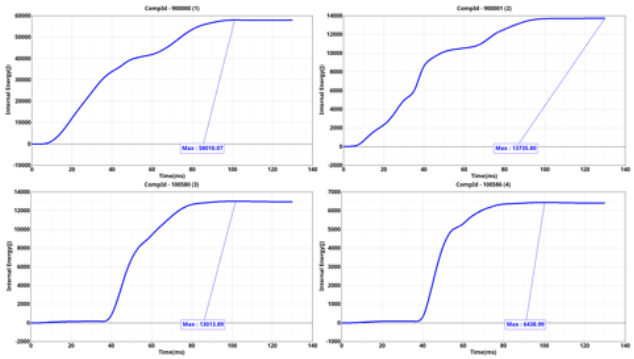
Vehicle Mass & Geometric Measurements

Vehicle Mass (kg)	1826.09 kg
Front Axle weight %	55.67%
Rear Axle weight %	44.33%



Material Internal Energy Summary





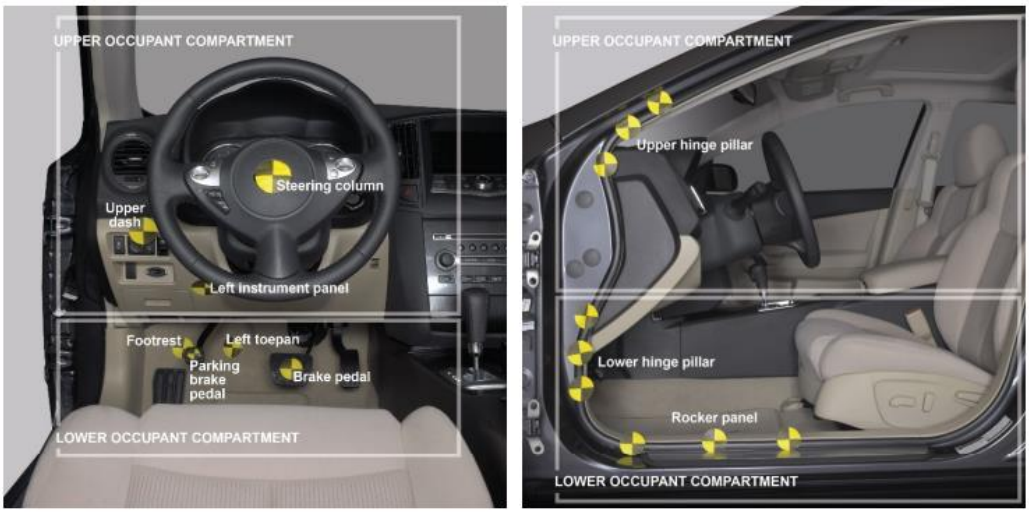
SORB Intrusion

This module is used to measure the vehicle intrusion as per IIHS – Small Overlap Barrier crash tests. The test vehicle is aligned with the rigid barrier such that the right edge of the barrier face is offset to the left of the vehicle centerline by 25 ± 1% of the vehicle width.

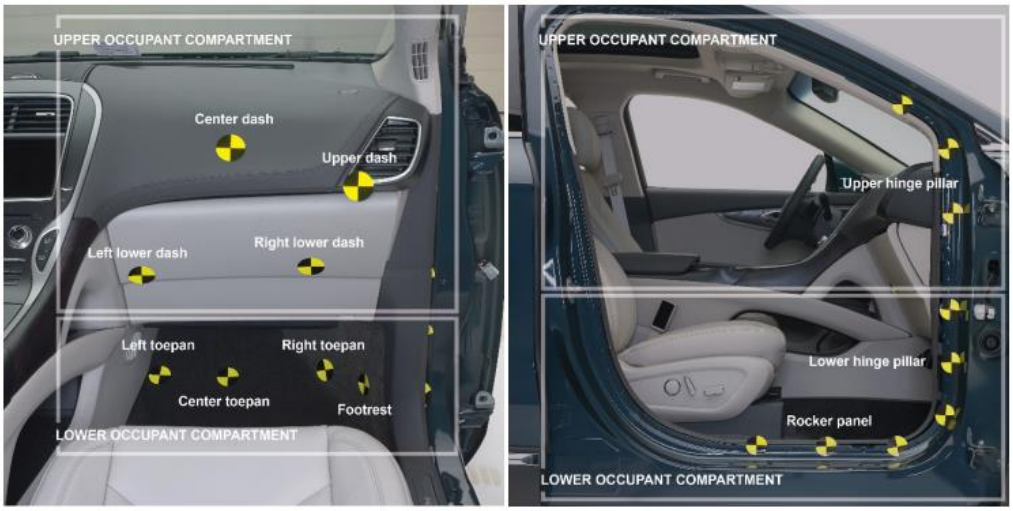
A total of 18 measurement locations are used in general (on the driver-side interior & exterior of the vehicle) and their longitudinal, lateral & vertical displacements with respect to a user defined coordinate system are measured.

The following are the measurement points & their locations for measuring vehicle intrusion.

Locations for Measuring Vehicle Intrusion – Driver side:



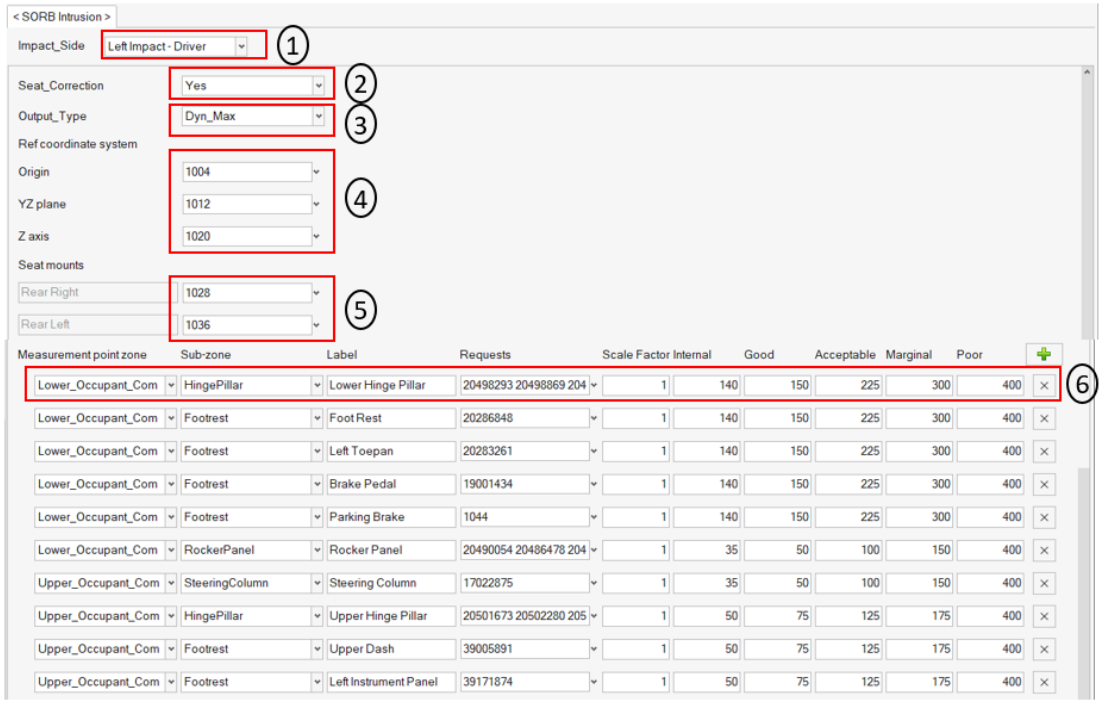
Locations for Measuring Vehicle Intrusion – Passenger side:



Steering column (one point), left instrument panel (one point), brake pedal (one point), parking brake pedal (one point), footrest (one point), seat bolts (two points), left toe pan (one point), upper dash (one point), lower hinge pillar (three points), upper hinge pillar (three points) and rocker panel (three points).

In addition, user can enter the scale factor along with the criteria values for each of the measurement points. User can also enter as many additional measurement locations as needed.

A detailed report is generated automatically. The report consists of an intrusion chart and a summary table displaying the intrusion values (actual & scaled values) for all the measurement points along with SORB rating info (Lower & upper occupant compartment rating as well as overall rating). The report also consists of relative displacement plots for all the points.

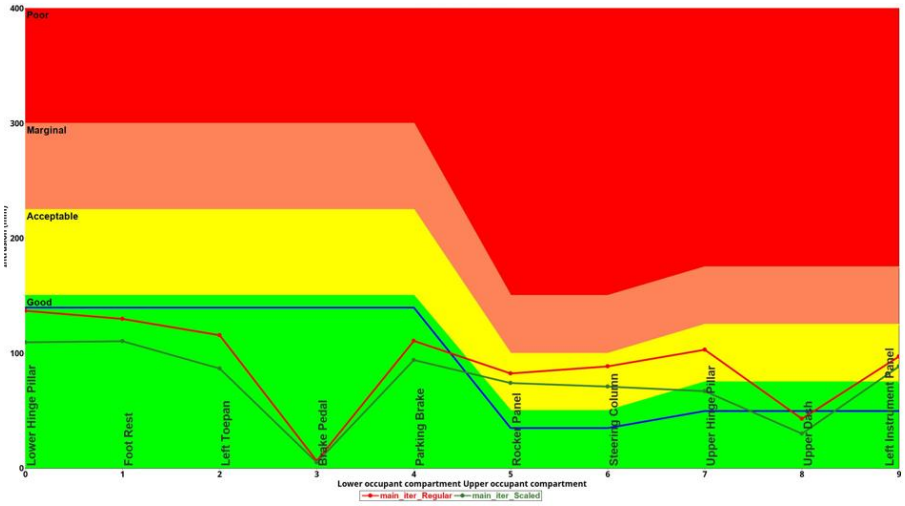


Inputs:

1) The impact side (left or right impact side with driver or passenger)
2) The seat correction option, whether seat correction should be considered or not when calculating the intrusions
3) The timestep at which intrusions should be measured (last timestep or dynamic max timestep)
4) Reference coordinate system, which is a right-handed, three-axis orthogonal coordinate system that is used for intrusion measurements
5) The request IDs for the two seat bolts (Rear left & right locations)
6) The request IDs for all the measurement locations where intrusions will be measured

Outputs

Intrusion Chart:



Occupant Kinematics Modifier	
Seat Attachment Relative Vert. Displ. ≥ 60 mm	0.10

Structure Modifiers	
Structural Integrity	Not Assessed
Fuel/HEV System Integrity	Not Assessed

Summary table with SORB rating:

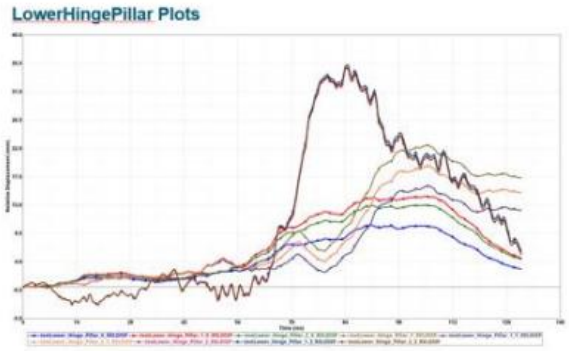
Location	Scale Factor	Intrusion (mm)	
		Last	Scaled
Lower Hinge Pillar	0.80	137.10	109.68
Foot Rest	0.85	130.14	110.62
Left Toepan	0.75	115.90	86.93
Brake Pedal	0.82	6.37	5.22
Parking Brake	0.85	110.86	94.23
Rocker Panel	0.90	82.59	74.33
Steering Column	0.80	88.85	71.08
Upper Hinge Pillar	0.65	103.14	67.04
Upper Dash	0.70	43.24	30.27
Left Instrument Panel	0.91	97.39	88.62

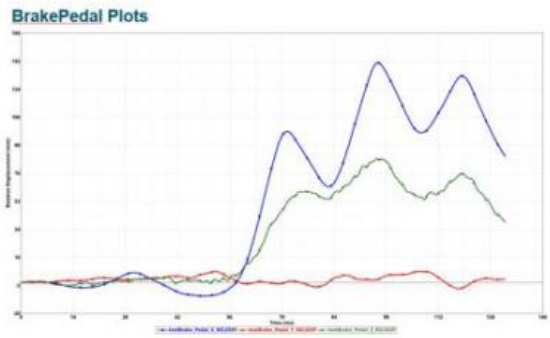
Occupant Kinematics Modifier	
Seat Attachment Relative Vert. Displ. ≥ 60 mm	0.10

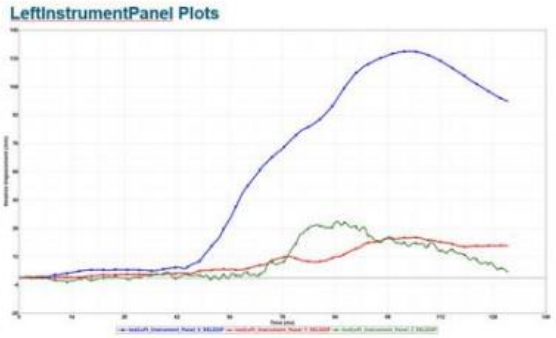
Structure Modifiers	
Structural Integrity	Not Assessed
Fuel/HEV System Integrity	Not Assessed

SORB Rating	
Lower Rating	GOOD
Upper Rating	ACCEPTABLE
Overall Rating	ACCEPTABLE

Relative Displacement plots:

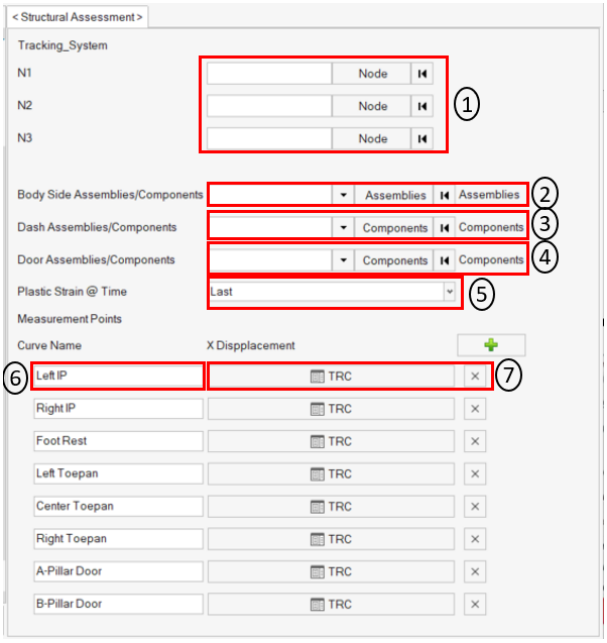






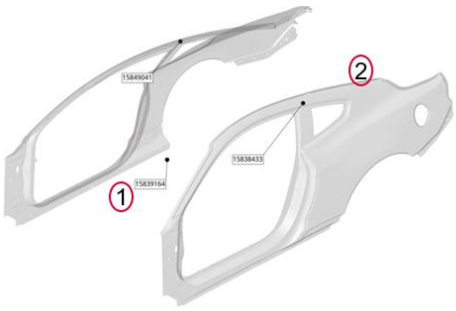
Structural Assessment

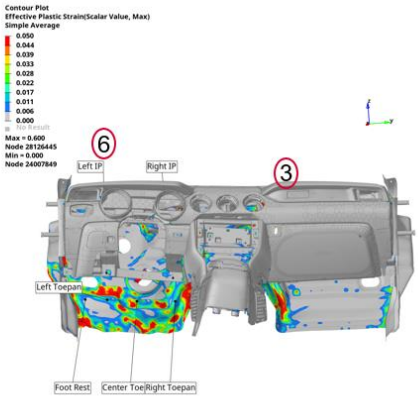
This module is used to create Effective Plastic Strain (EPS) contour on Dash & Door assemblies and locates & highlights various measurement points such as Left IP, Right IP, Footrest etc.

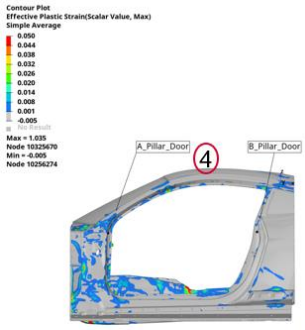


Inputs:

1) The 3 nodes N1, N2 & N3 (request Ids) required for defining tracking system
2) The body side component IDs required for capturing tracking system nodes
3) The Dash assembly ID required for highlighting measurement points
4) The Door assembly ID required for highlighting A-Pillar & B-Pillar nodes
5) The time step at which plastic strain contour should be applied
6) Measurement point name
7) Measurement point channel info (TRC) from Time History file (binout)

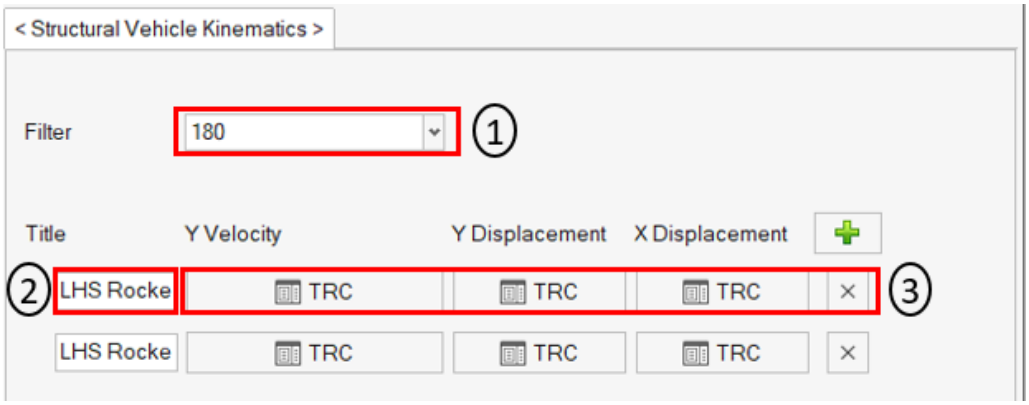






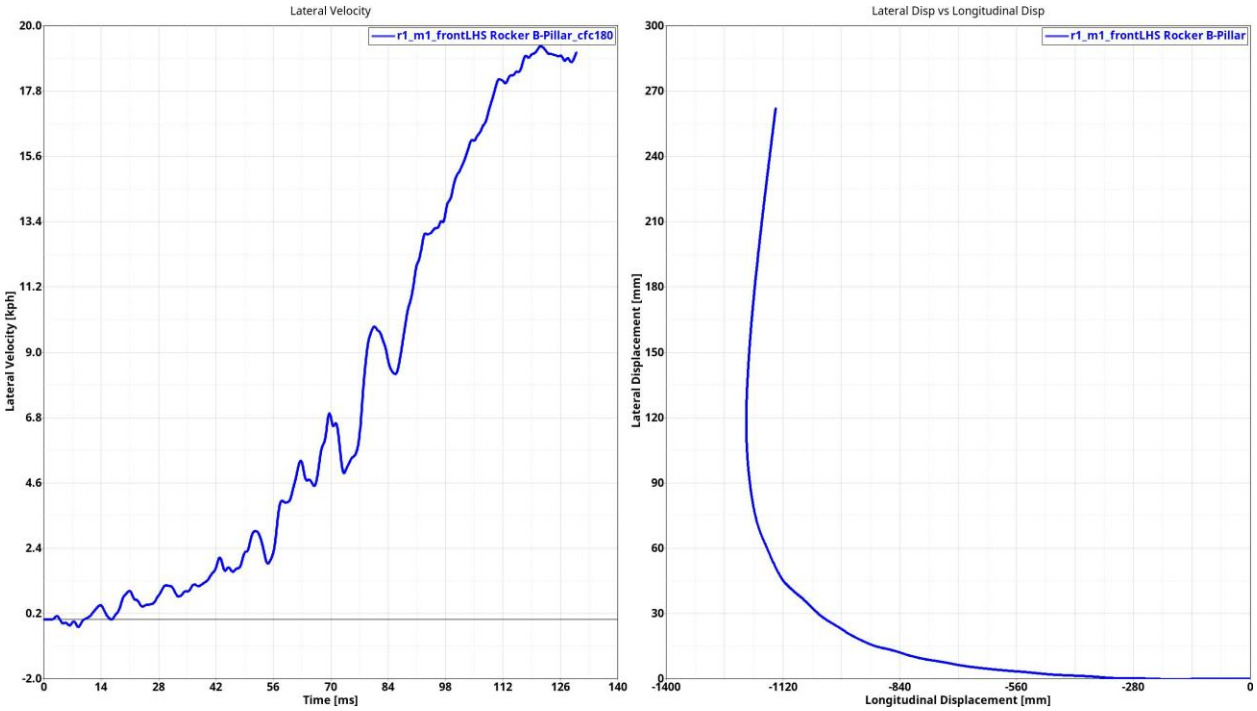
Structural Vehicle Kinematics

This module lets you create plots such as lateral velocity and lateral vs longitudinal displacement for user selected nodes from the Time History file.



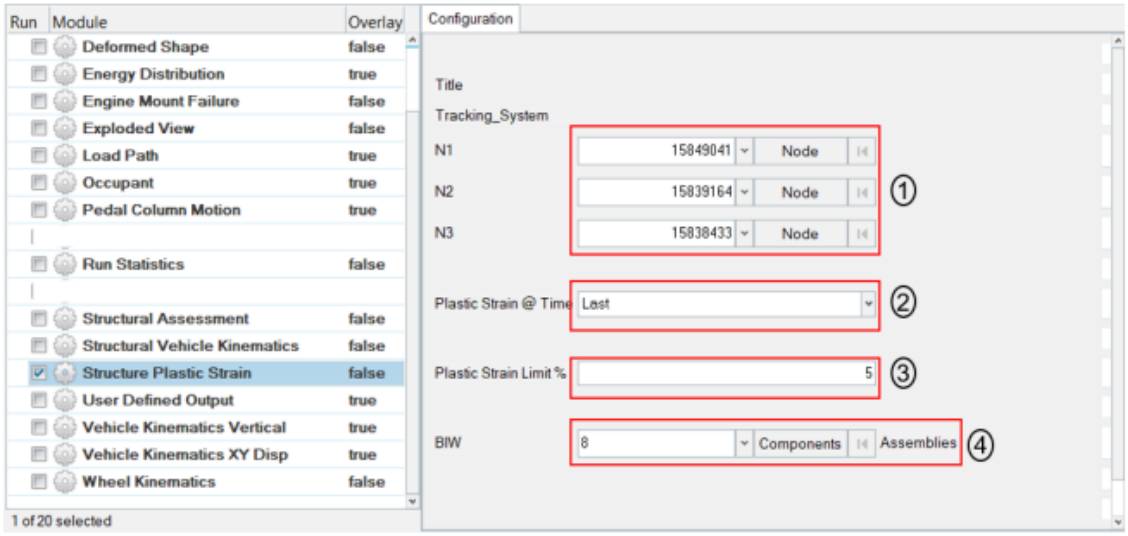
Inputs:

1) The filter class to be used
2) The label used as curve name when plotting
3) The data type, request and component info for each of the user selected locations from the time history file



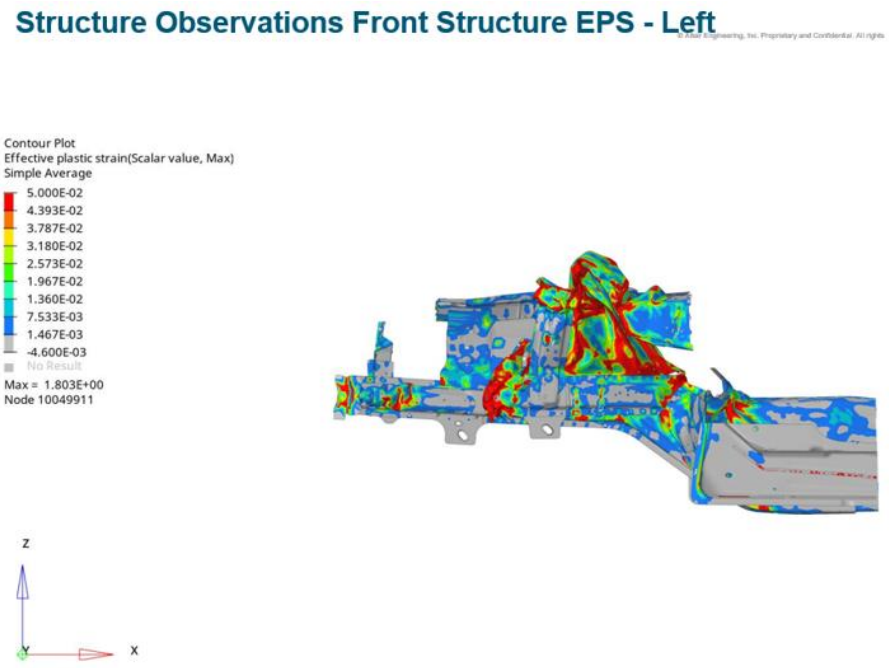
Structure Plastic Strain

This module allows to plot plastic strain for front structures that include BIW & subframes. The plastic strain result data type is contoured, plastic strain limit is set as per user input and four specific images are captured in Left, Right, Top & Bottom views.



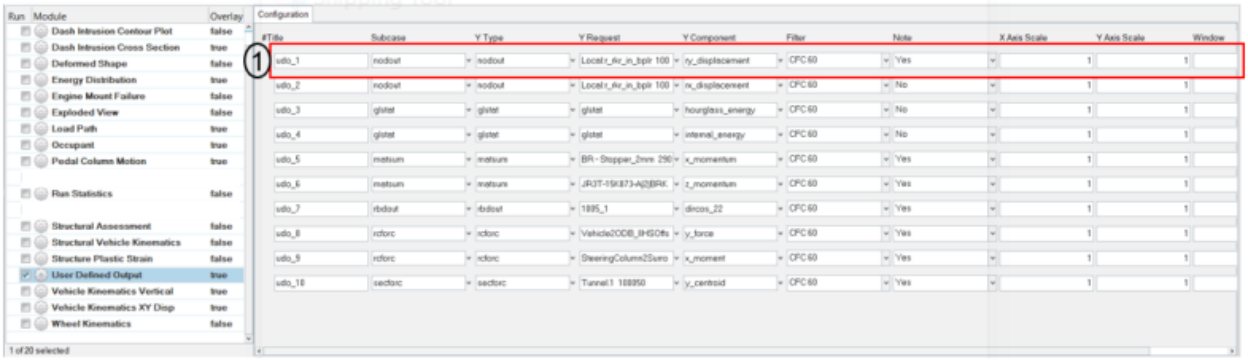
Inputs:

1) The 3 node IDs (request ID) required for defining tracking system
2) The time step (Last / Max) at which plastic strain contour should be applied
3) The plastic strain limit to be used as upper limit for contour legend
4) The BIW assembly or component ID



User Defined Output

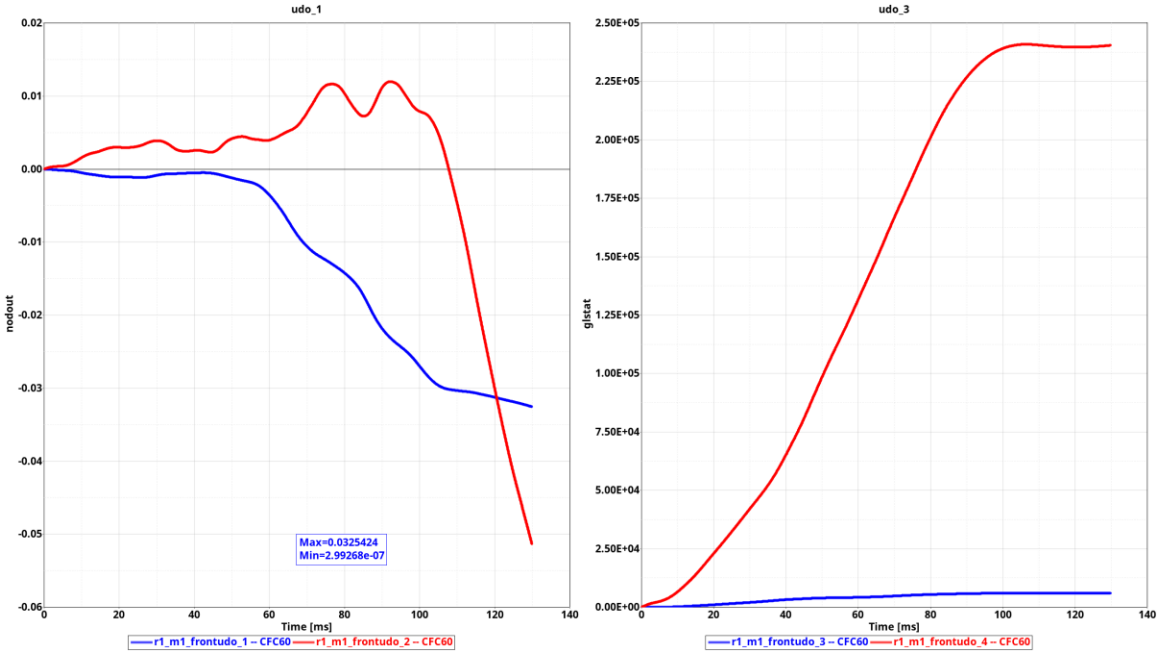
As the name suggests this module allows users to plot program specific Time History data. The plots are created based on user defined list of inputs as shown in the UI below.



Inputs:

For each user defined plot, following set of inputs are required.

- Label to be used as plot header
- Subcase name, Y Type, Y Request & Y Component from the Time History file
- Filter class to be used
- Note with Min & Max value is required to be created
- X & Y axes scale factors if required to be used
- Window number to be used when plotting the curves
- Y axis unit to be used for plotting the Y vector



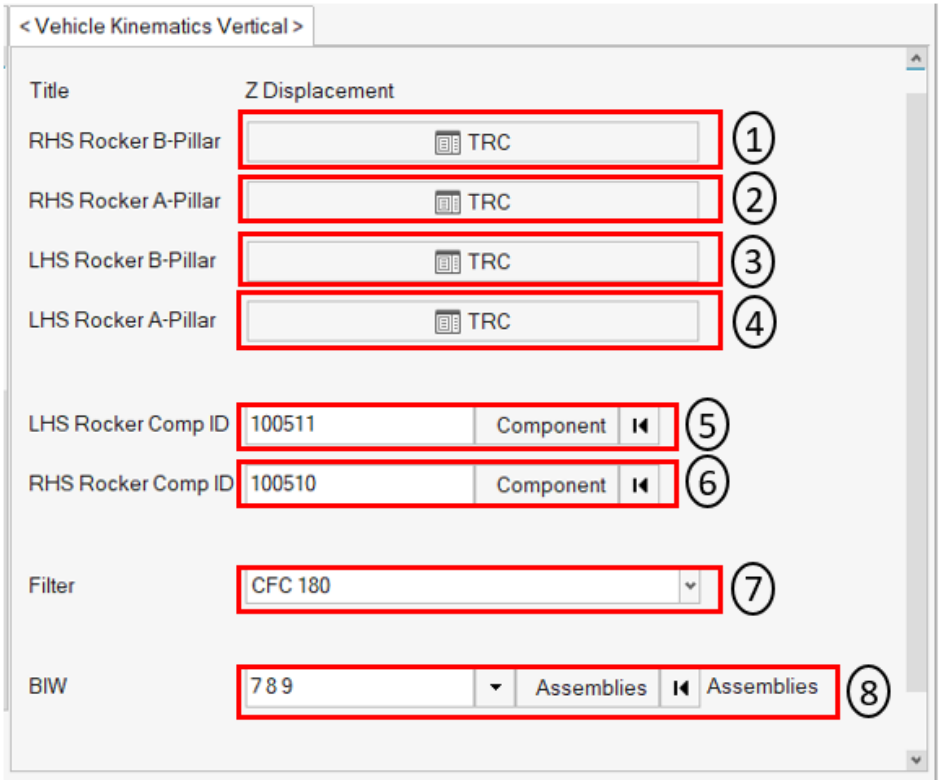
Vehicle Kinematics Vertical

This module generates a vertical (Z) displacement plots for LHS & RHS Rocker A-Pillar & B-Pillar node IDs (request IDs), The report contains following info.

1) A summary table capturing Z displacement min & max values along with time step values for LHS & RHS Rocker A-Pillar & B-Pillar node IDs

2) Images isolating BIW & LHS & RHS Rocker parts

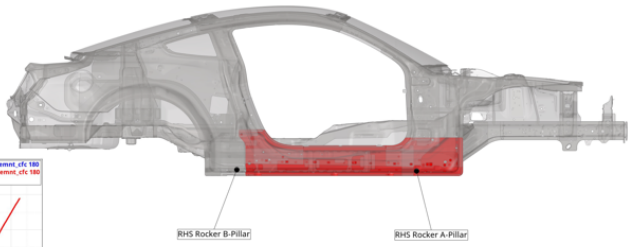
3) LHS & RHS Z displacement plots along with average plots for both A-Pillar and B-Pillar node IDs

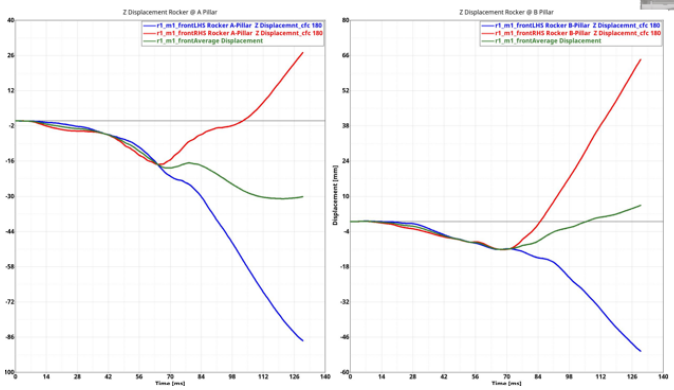


Inputs:

1) RHS Rocker B-Pillar request ID from Time History file (binout)
2) RHS Rocker A-Pillar request ID from Time History file (binout)
3) LHS Rocker B-Pillar request ID from Time History file (binout)
4) LHS Rocker A-Pillar request ID from Time History file (binout)
5) LHS Rocker component ID
6) RHS Rocker component ID
7) The cfc filter class to be used
8) BIW component or assembly IDs

Title	Vertical Displacement			
	r1_m1_front			
	MAX [mm]	TIME [msec]	MIN [mm]	TIME [msec]
A Pillar [LHS]	0.00	0.00	-87.43	129.92
A Pillar [RHS]	27.21	129.92	-17.29	64.64
A Pillar [Average]	0.00	0.00	-30.96	120.80
B Pillar [LHS]	0.14	7.44	-51.60	129.92
B Pillar [RHS]	64.47	129.92	-11.21	69.04
B Pillar [Average]	6.43	129.92	-11.13	67.36





Vehicle Kinematics XY Displacement

This module generates following summary report for the Rocker A-Pillar and B-Pillar LHS & RHS nodes.

1) It plots X & Y direction Acceleration, Velocity, Displacement plots along with average plots.

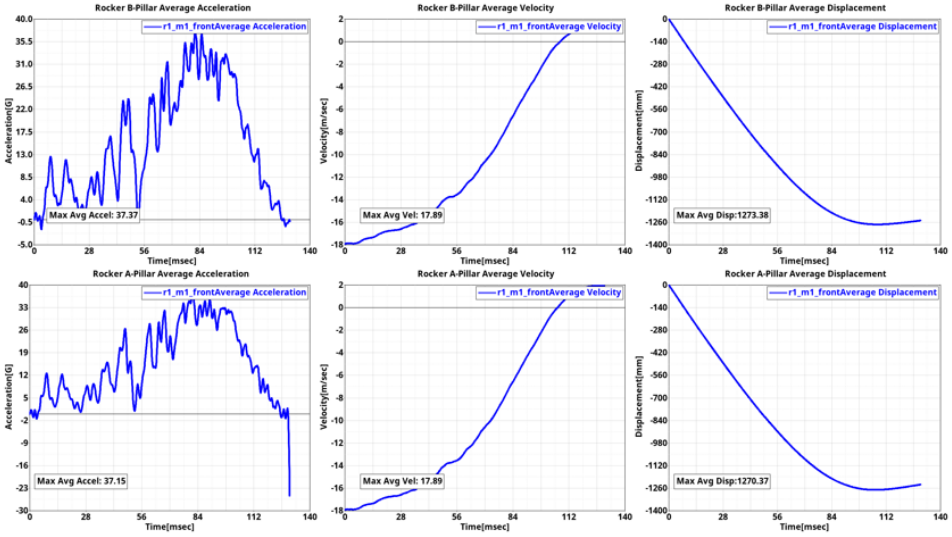
2) It creates a summary table with the max values for the above plots.

Inputs:

1) RHS Rocker B-Pillar request ID from Time History file (binout)
2) RHS Rocker A-Pillar request ID from Time History file (binout)
3) LHS Rocker B-Pillar request ID from Time History file (binout)
4) LHS Rocker A-Pillar request ID from Time History file (binout)
5) The cfc filter class to be used when plotting for above request IDs

Outputs:

	Title	Max Acceleration			Max Velocity			Max Displacement		
		RHS	LHS	Average	RHS	LHS	Average	RHS	LHS	Average
r1_m1_front	Rocker B-Pillar	40.75	46.16	37.37	17.90	17.89	17.89	1360	1208	1273
	Rocker A-Pillar	47.75	39.47	37.15	17.89	17.90	17.89	1207	1348	1270

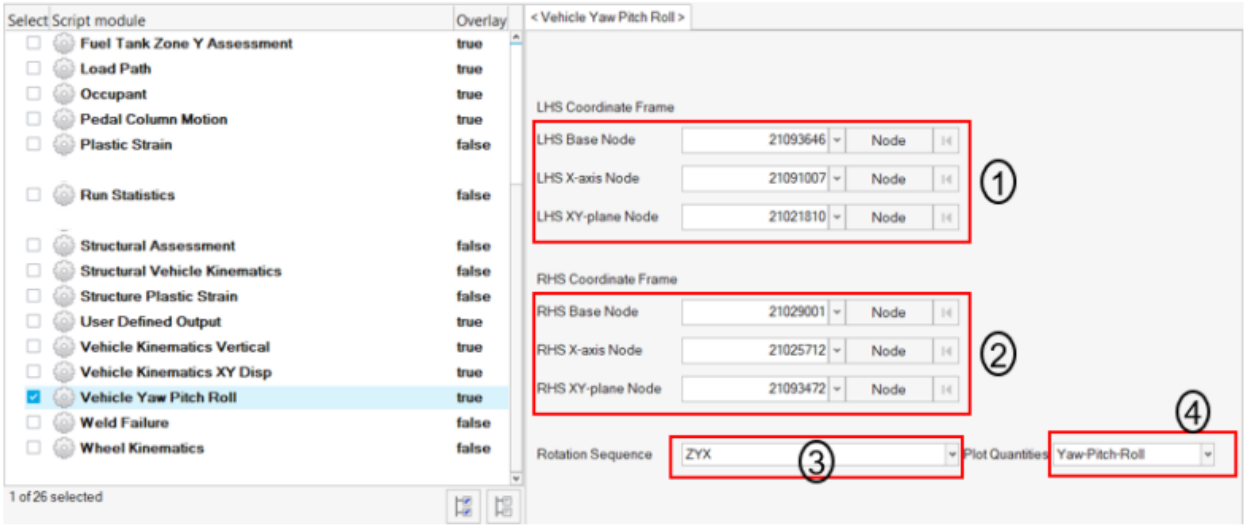


Vehicle Yaw Pitch Roll

This module generates the summary report capturing the vehicle rotations (yaw, pitch & roll) for the user selected coordinate frames. The module requires input selection of 2 nodes to define just the X-axis definition, or 3 nodes to define the X-axis and the XY-plane.

The Yaw, Pitch and Roll angles are calculated using Euler angles with the definition at Time=0.0 taken as the starting orientation. The default for the rotation sequence is "ZYX" and the user has the option to change to any of 5 other pre-defined sequences. User can also select between plotting 2 of the 3 angles or all 3 angles. If input is defined for the Left-Hand Side and Right-Hand Side coordinate systems, the average of the two is also plotted.

1) It plots LHS, RHS & Average yaw, pitch & roll plots based on the inputs defined
2) It also creates a summary table with the yaw, pitch & roll values (in degrees)



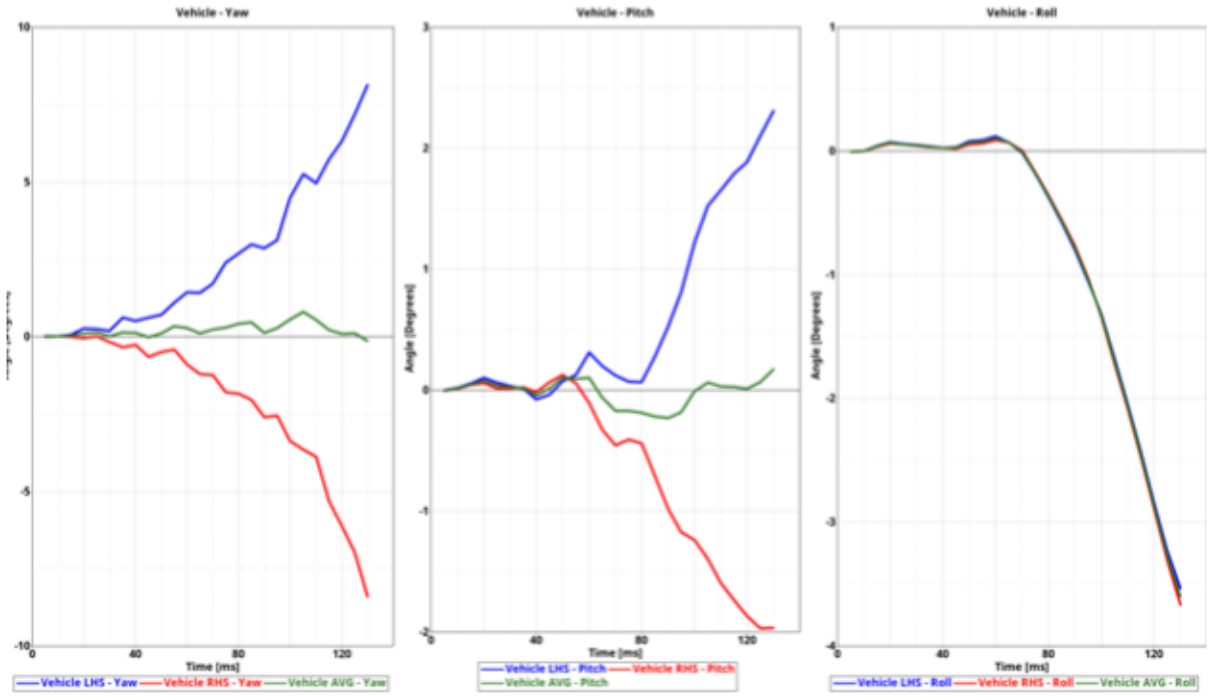
Inputs:

1) 3 nodes defining LHS coordinate frame (3D model)
2) 3 nodes defining RHS coordinate frame (3D model)
3) Rotation sequence (ZYX, ZXY, XYZ, XZY, YZX & YXZ)
4) Quantity to be plotted

Outputs:

Vehicle Yaw / Pitch / Roll			
Side	Yaw [degrees]	Pitch [degrees]	Roll [degrees]
LHS	8.138	2.313	3.538
RHS	8.402	1.967	3.669
AVG	0.804	0.228	3.603

Vehicle YawPitchRoll Plot



Weld Failure

This module generates a detailed report of all the welds ruptured based on the user selected weld material. Following weld types are supported.

a. 1D beam spot welds

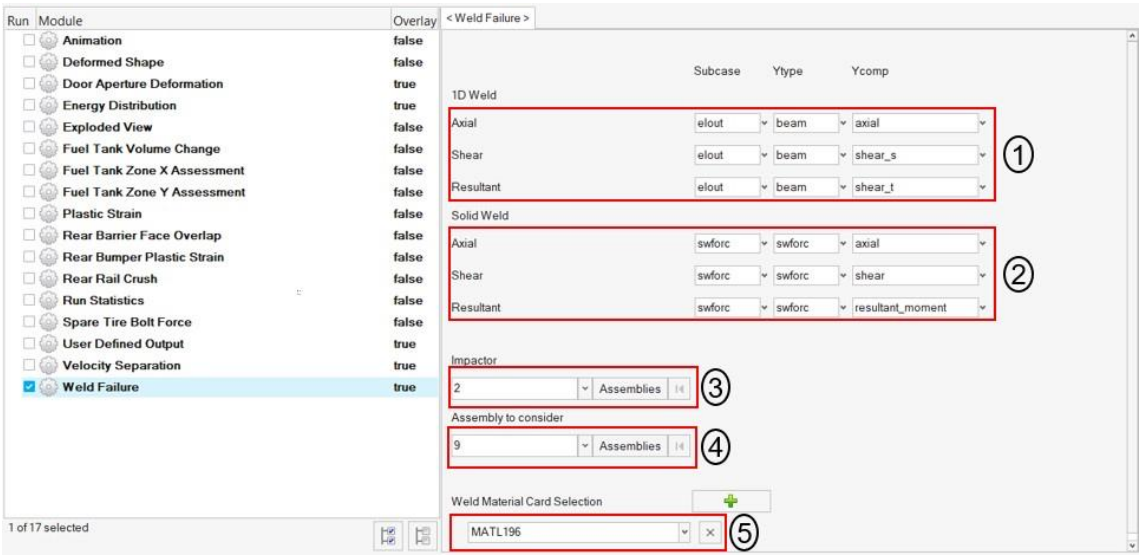
b. Single hexa spot welds

c. Hexa nuggets (cluster of hexa elements)

d. Hexa adhesives

The detailed PPT report generated can be categorized into following different sections.

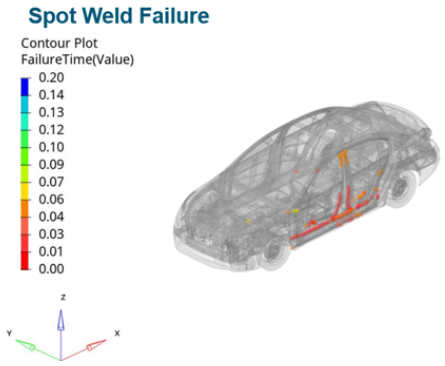
- First two slides give you the global viewpoint. It contains the complete view of the vehicle withall the ruptured welds color coded as per the failure time contour & another slide showing the cumulative graph of the ruptured welds across the simulation time steps.
- The subsequent slides capture the detailed report for each of the ruptured weld for each of theweld type found in the model.
- For 1D beam spot weld & single hexa spot weld types, the report contains an isolated view ofthe weld & its linked components & a graphs showing the axial, shear & resultant plots acrossthe time steps.
- For hexa nuggets & hexa adhesive weld types, the report contains detailed view of the weldcontaining the linked components.

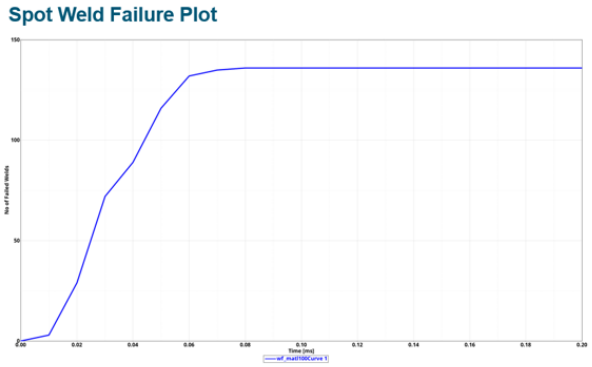


Inputs:

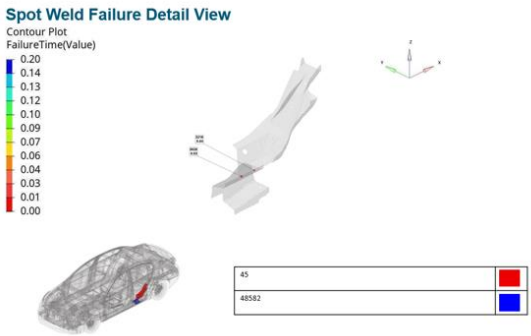
1) The time History info (binout) to be used for 1D beam spot welds axial, shear & resultant graphs
2) The time History info (binout) to be used for single hexa spot welds axial, shear & resultant graphs
3) Impactor assembly / component ID
4) Assembly ID / Component ID list (optional) to be used to find ruptured welds for reportgeneration
5) Weld material ID used to find the ruptured welds

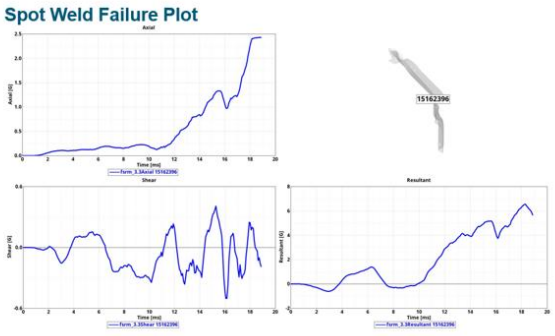
Global viewpoint:



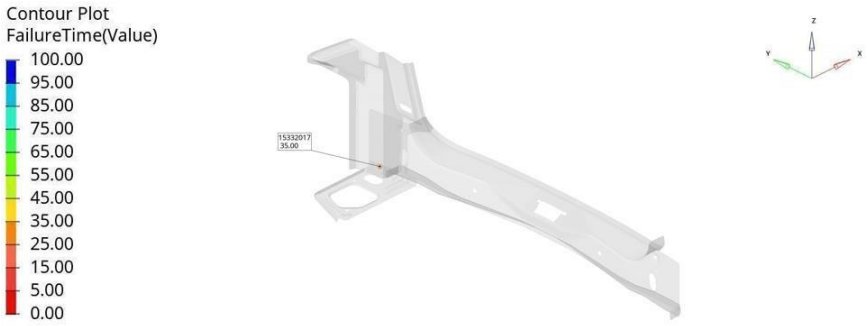


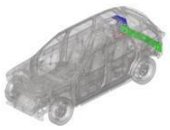
1D beam spot weld / Single hexa spot weld report





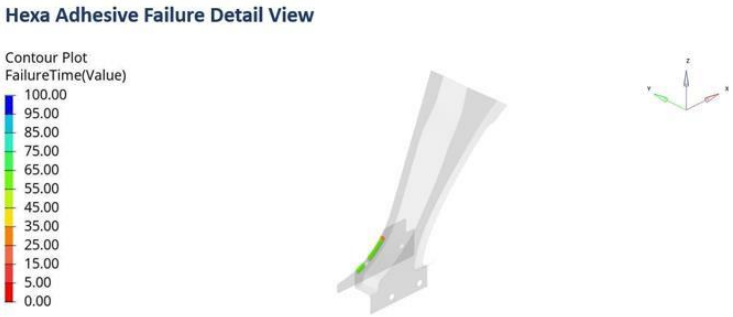
Hexa nuggets report:

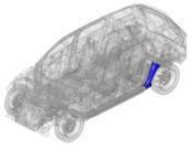




R2FB_S11146_A|EXT|FLR|PAN|SD|RR|0.8mm	
R2HB-S27944-A|10|REINF RR LP OPG LWR|0.8mm	
R2HB-S40492-A|22|PNL LWR BK I|S|0.7mm	

Hexa adhesives report:

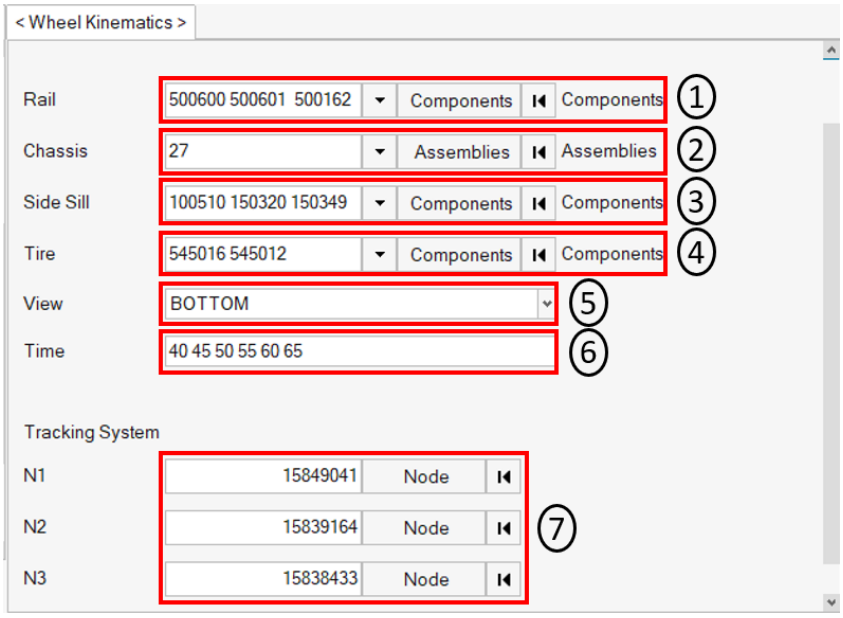




1)R2FB-S29299-A|13|BRKT QTR PNL TO WHL/HS|0.65mm 2)FNA7537534|1|XXXX-X279A33-A (SUPT BDY SD PNL TO WHL/HS LH)|0.95mm

Wheel Kinematics

The wheel kinematics module lets you generate report containing images (bottom or top view) highlighting suspension, wheel & rocker at various user defined time steps.



Inputs:

1) Rail assembly or component IDs
2) Chassis assembly or component IDs
3) Side Sill assembly or component IDs
4) Tire assembly or component IDs
5) View to be used when capturing images
6) The time steps at which the images should be captured
7) The 3 node IDs defining the tracking system from animation file