

Altair Safety Report Manager

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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.

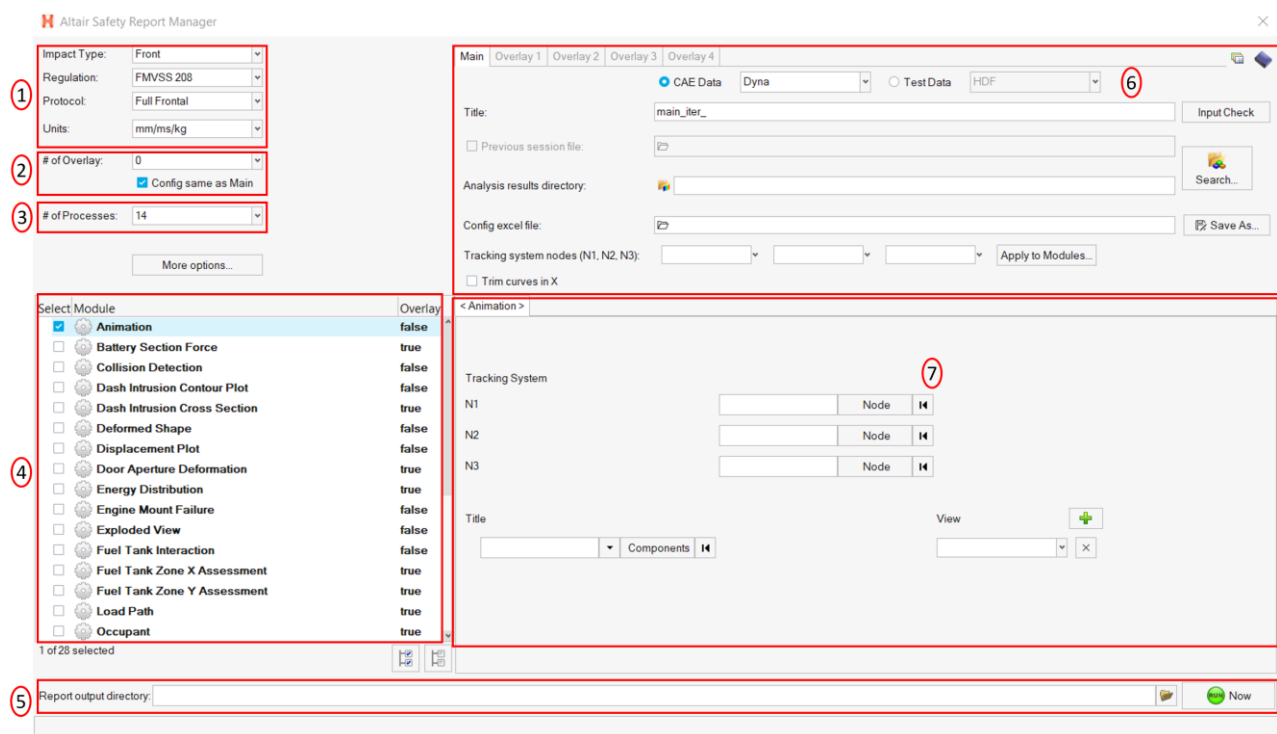
- Model information
- Run quality statistics
- Occupant requirements
- Structure requirements
- Structure overview
- User defined plots

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.

Impact Type:	Front
Regulation:	FMVSS 208
Protocol:	Full Frontal
Units:	mm/ms/kg

Overlay selection section

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

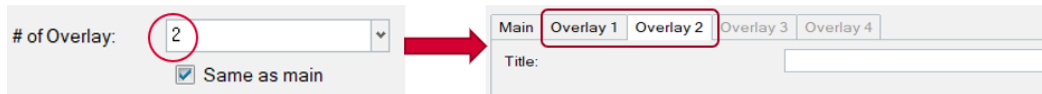
- When you want to generate report for a single run then you would set overlay option to 0. Therefore, overlay tabs (in section #6) is disabled.

# of Overlay:	0	Same as main
---------------	---	--------------

→

Main	Overlay 1	Overlay 2	Overlay 3	Overlay 4
Title:				

- 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.

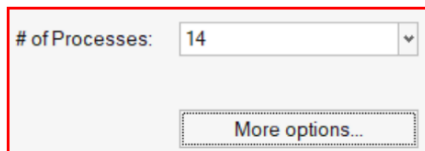


Please note that only those modules which run in HyperGraph (that create curves / graphs) are supported for overlay mode. There is a specific overlay status column next to modules list that indicates the overlay support for each module.

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

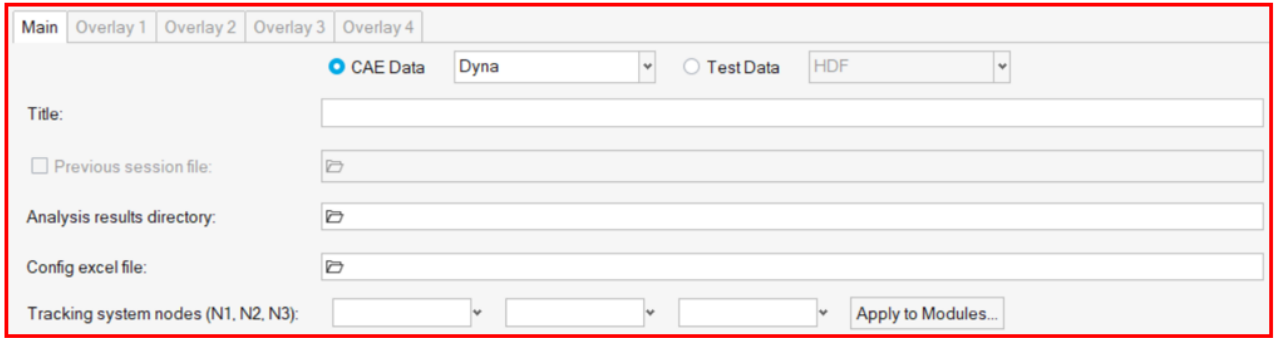
In this section user will select the output directory path. This is where all the output files such as the session files, images, animations, PPT report & log files from the ASRM run will be created.

Main section

Input directory, data type & configuration section

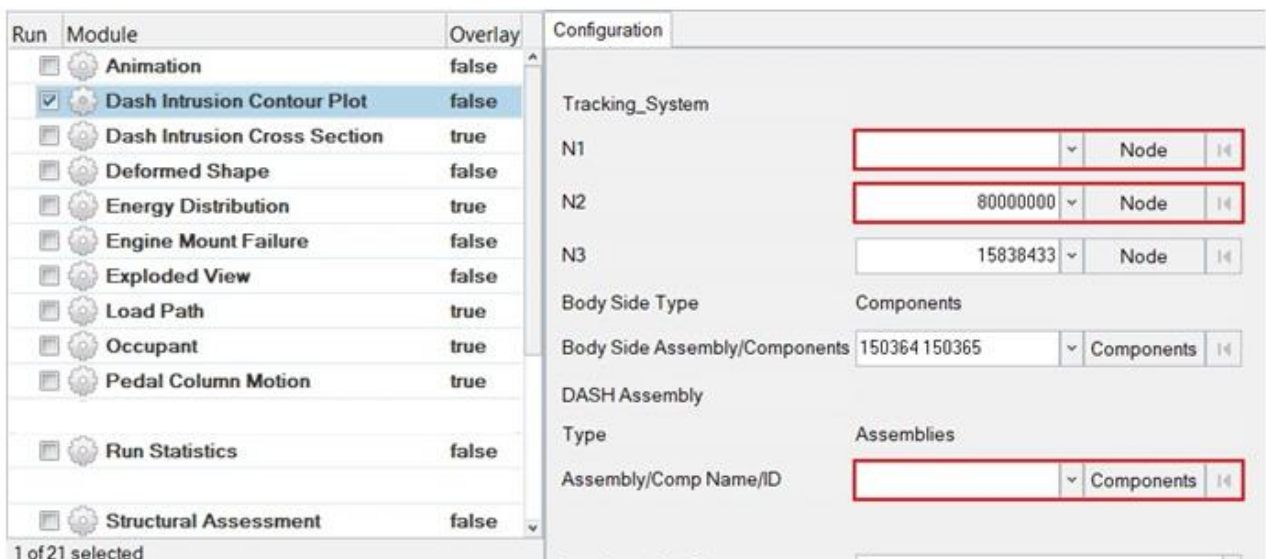
In this section, user should select the following.

- 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.

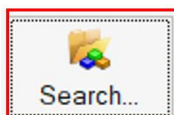


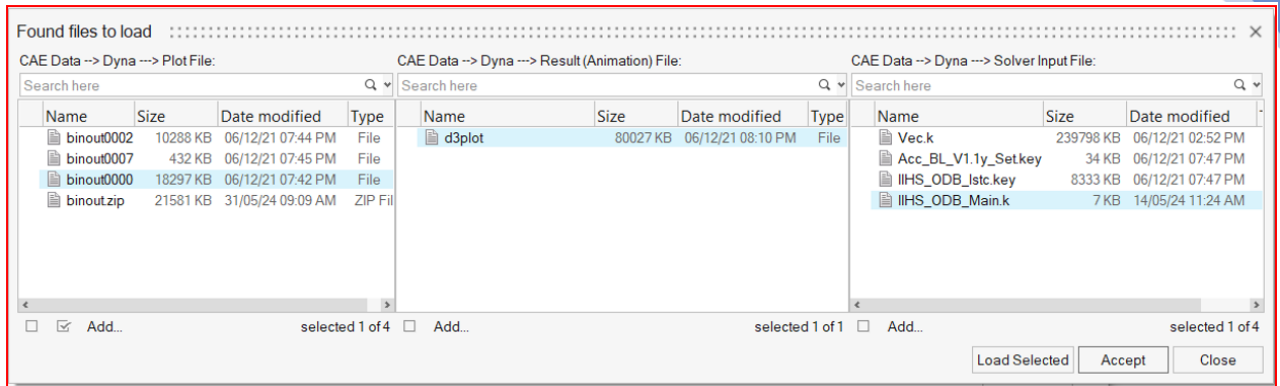
Run	Module	Overlay
<input type="checkbox"/>	Animation	false
<input checked="" type="checkbox"/>	Dash Intrusion Contour Plot	false
<input type="checkbox"/>	Dash Intrusion Cross Section	true
<input type="checkbox"/>	Deformed Shape	false
<input type="checkbox"/>	Energy Distribution	true
<input type="checkbox"/>	Engine Mount Failure	false
<input type="checkbox"/>	Exploded View	false
<input type="checkbox"/>	Load Path	true
<input type="checkbox"/>	Occupant	true
<input type="checkbox"/>	Pedal Column Motion	true
<input type="checkbox"/>	Run Statistics	false
<input type="checkbox"/>	Structural Assessment	false

Configuration	
Tracking_System	
N1	<input type="text"/> Node
N2	<input type="text"/> 80000000 Node
N3	<input type="text"/> 15838433 Node
Body Side Type	Components
Body Side Assembly/Components	<input type="text"/> 150364 150365 Components
DASH Assembly	
Type	Assemblies
Assembly/Comp Name/ID	<input type="text"/> Components

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.

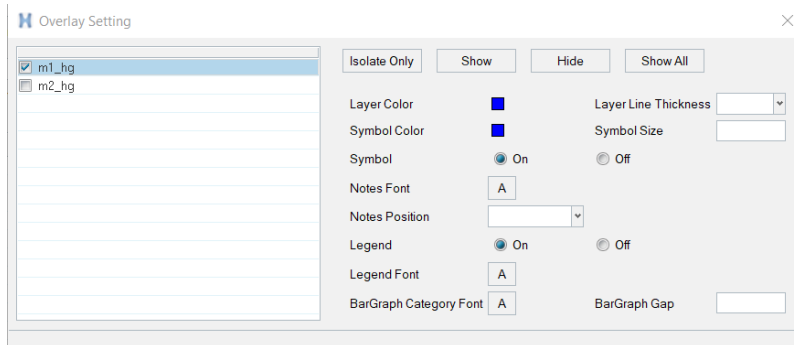





Change curve attributes & publish session

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.

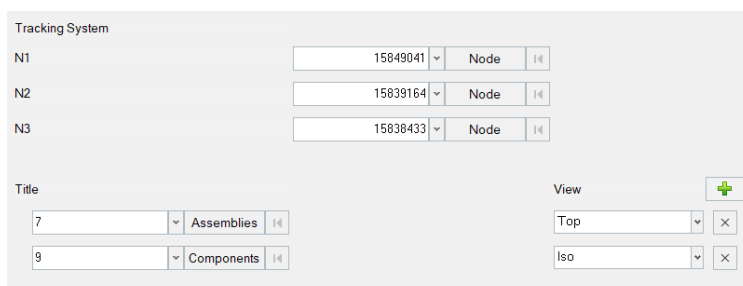


After changing the curve & note related attributes using the overlay setting dialog, user can click on Publish session icon  which would publish a report for the overlay session.

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.

< Occupant >

Driver: Passenger

Dummy Model: 50th Dummy Version: config Reset

iqDriver Restraint Type: Driver ID:

Driver Injury Criteria	Subcase	Datatype	Request	Component	Filter
HEAD_ACC_X	abstat		1	H340TH_DUMMY1_HEAD_ACCELEROMETER_X 2000001	
HEAD_ACC_Y	abstat			H340TH_DUMMY1_HEAD_ACCELEROMETER_Y 2000002	
HEAD_ACC_Z	abstat			H340TH_DUMMY1_HEAD_ACCELEROMETER_Z 2000003	
HEAD_ACC_RES	abstat			H340TH_DUMMY1_CHEST_ACCELEROMETER_X 2000004	
NECK_UPPER_MOMENT_Y	abstat			H340TH_DUMMY1_CHEST_ACCELEROMETER_Y 2000005	
NECK_UPPER_FORCE_X	abstat			H340TH_DUMMY1_CHEST_ACCELEROMETER_Z 2000006	
NECK_UPPER_FORCE_Z	abstat			H340TH_DUMMY1_PELVIS_ACCELEROMETER_X 2000007	
CHEST_DEFLECTION	abstat			H340TH_DUMMY1_PELVIS_ACCELEROMETER_Y 2000008	
CHEST_ACC_X					
CHEST_ACC_Y					
CHEST_ACC_Z					

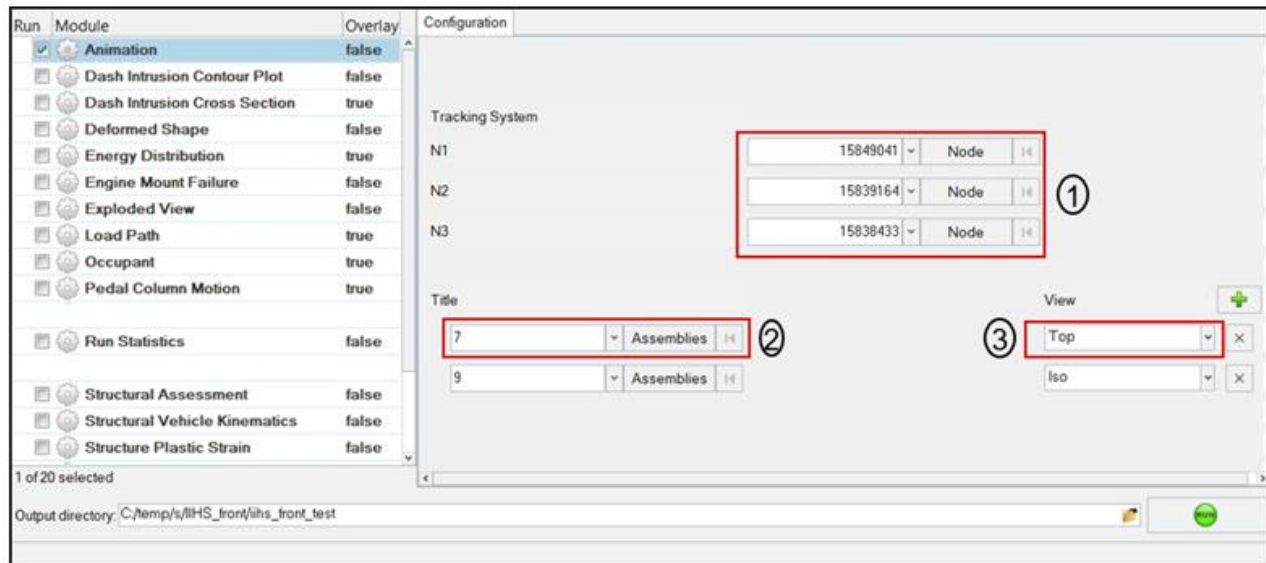
Modules

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

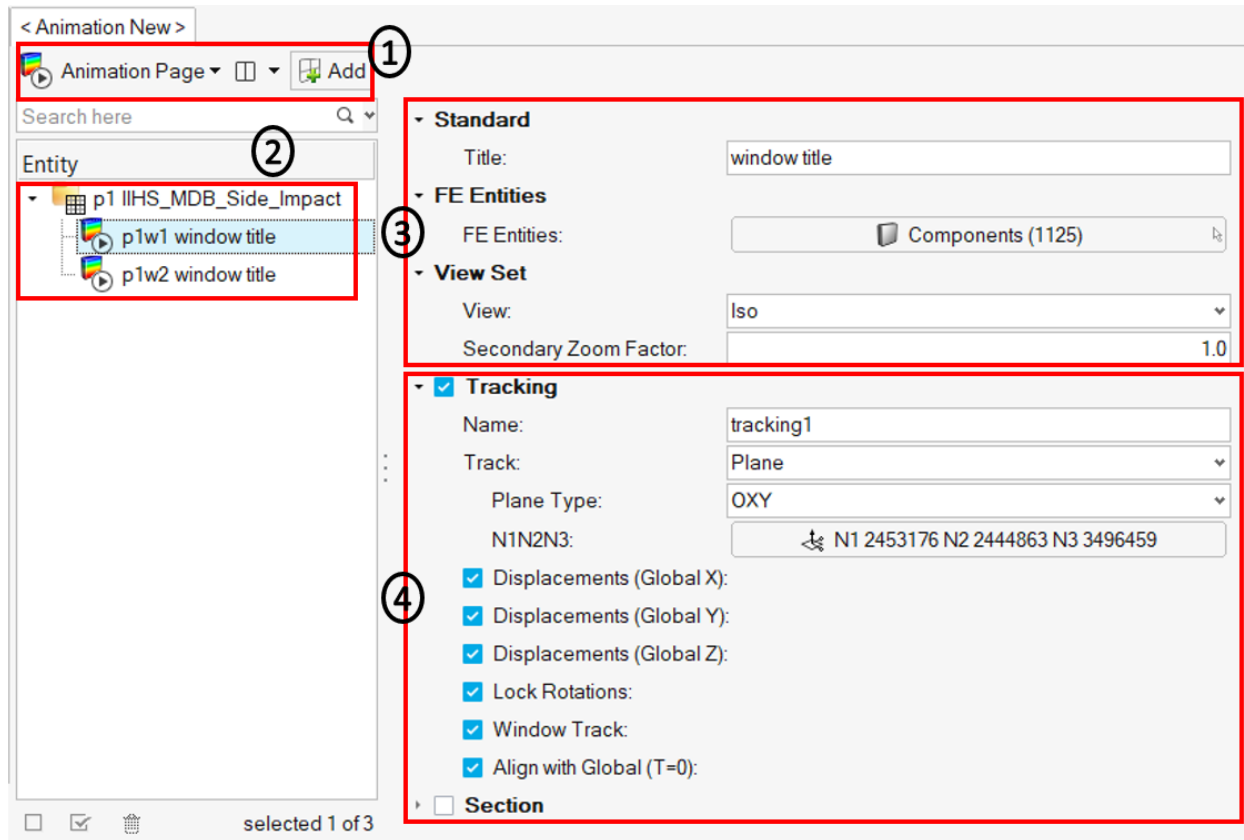
Output report:

Animation - Top View ③



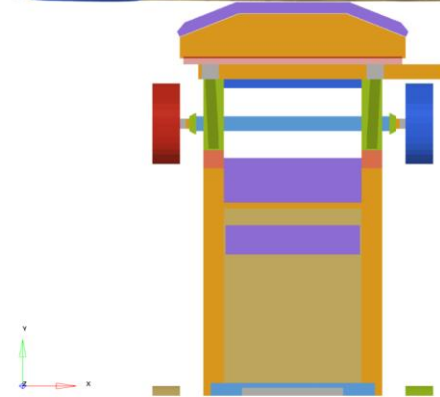
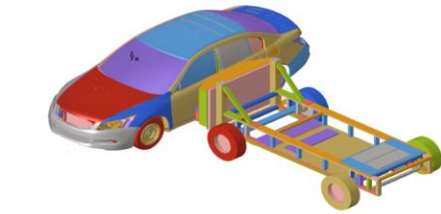
Animation New

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:

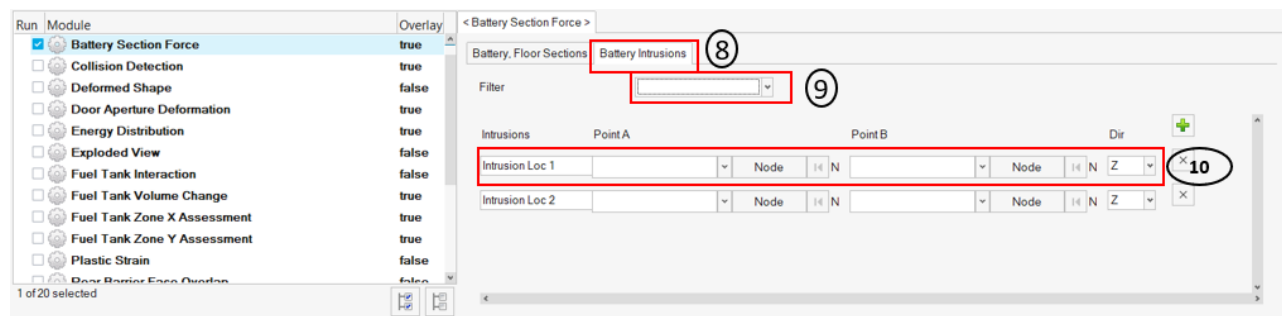
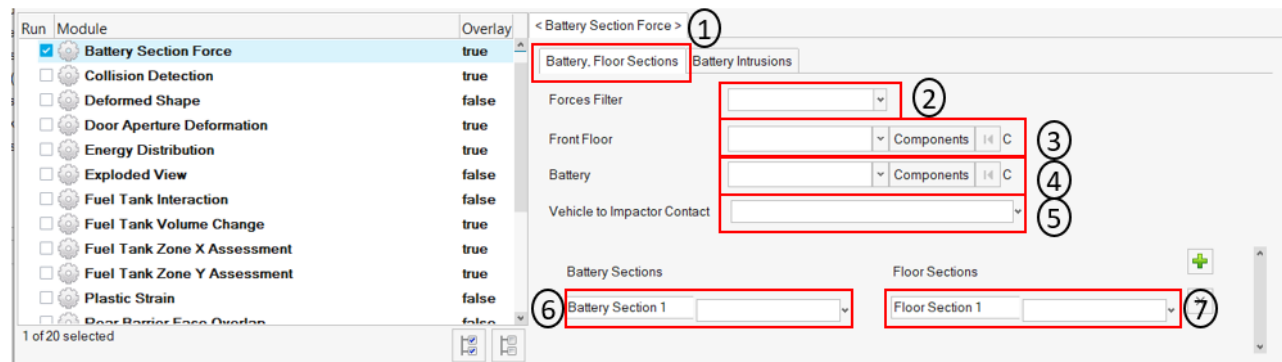
- 1) Use this input to select the page & window layout that will be captured and included in the report. 2 layouts are supported i.e. 1 x 1 and 1 x 2. Select the layout and click on **Add** button to add the page layout into the entity list browser.
- 2) The **Entity** list browser is used to list and 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.



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.

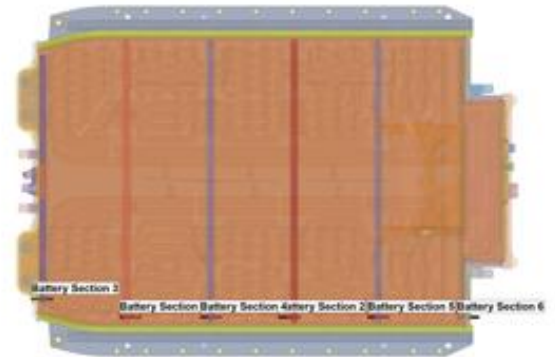
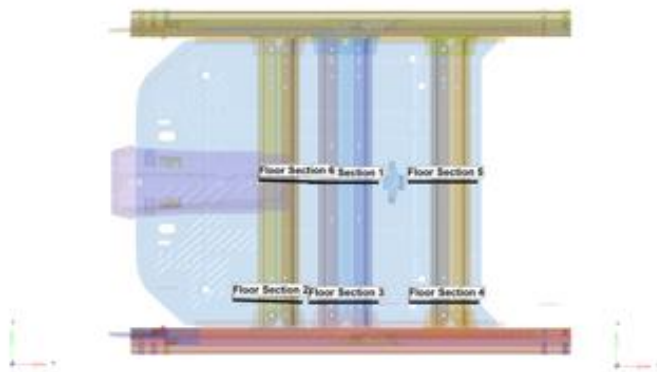
- 1) Images consisting of floor and the battery parts along with cross section members
- 2) A summary table showing the cross-member forces for all the user defined battery & floor sections
- 3) A summary table showing the battery intrusion measurements at various user selected locations
- 4) Images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

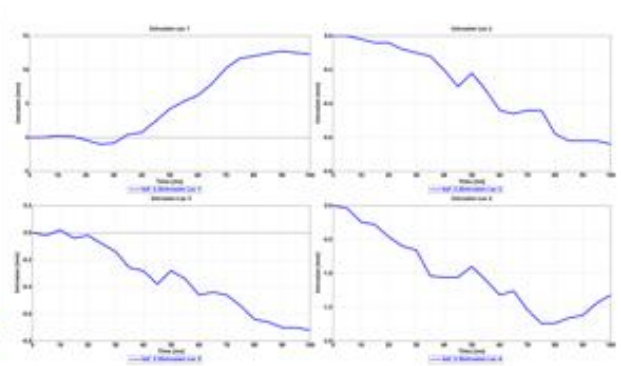
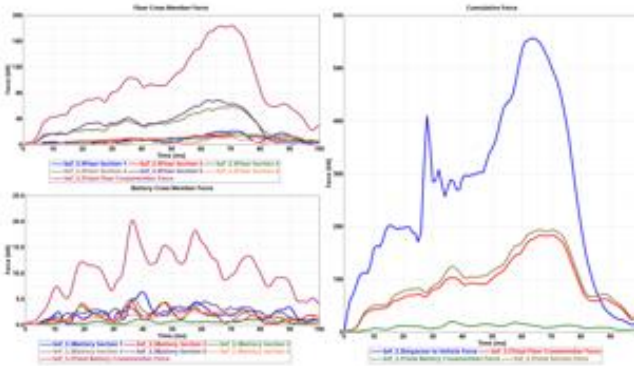
- 1) For battery & floor sections, following inputs are required.
 - a. Filter class to be used for applying the filter to battery & floor cross member section forces plots
 - b. Front floor & battery components or assemblies
 - c. Vehicle to Impactor contact request
 - d. User defined battery & floor 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:



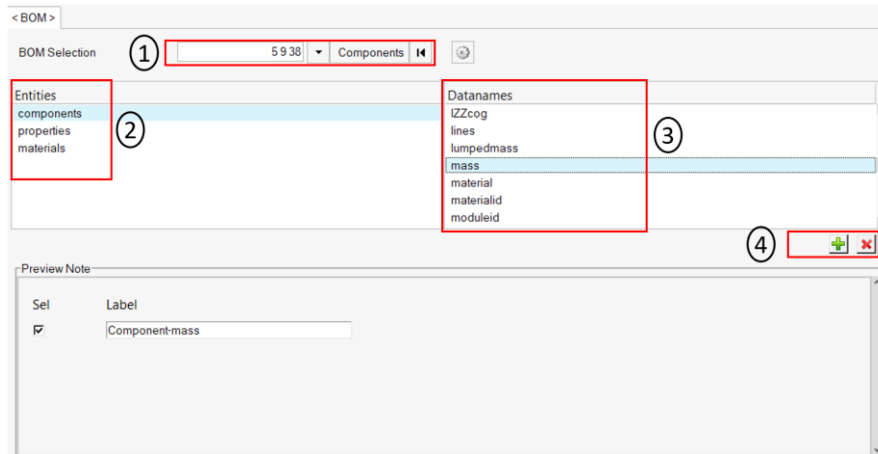
Battery Cross Member Force		Floor Cross Member Force	
Title	Force [kN]	Title	Force [kN]
Battery Section 1	6.37	Floor Section 1	20.89
Battery Section 2	4.44	Floor Section 2	16.18
Battery Section 3	1.07	Floor Section 3	15.36
Battery Section 4	5.10	Floor Section 4	58.88
Battery Section 5	4.56	Floor Section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

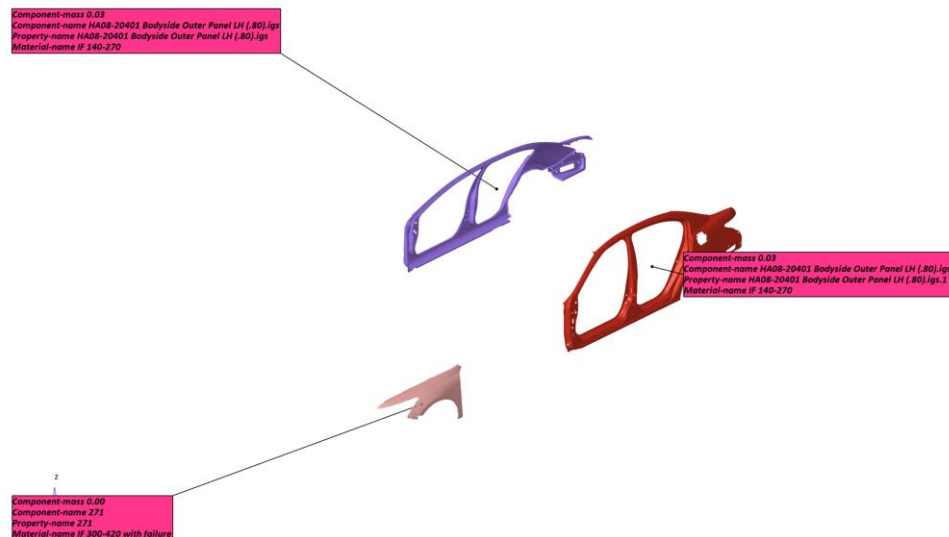
BOM module is an advanced exploded view module. It has the capability to include data name attributes as annotations in the report. Users can pick from several data names (around 100) related to components, property, and material entity attributes. The selected BOM info can be easily attached as annotations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

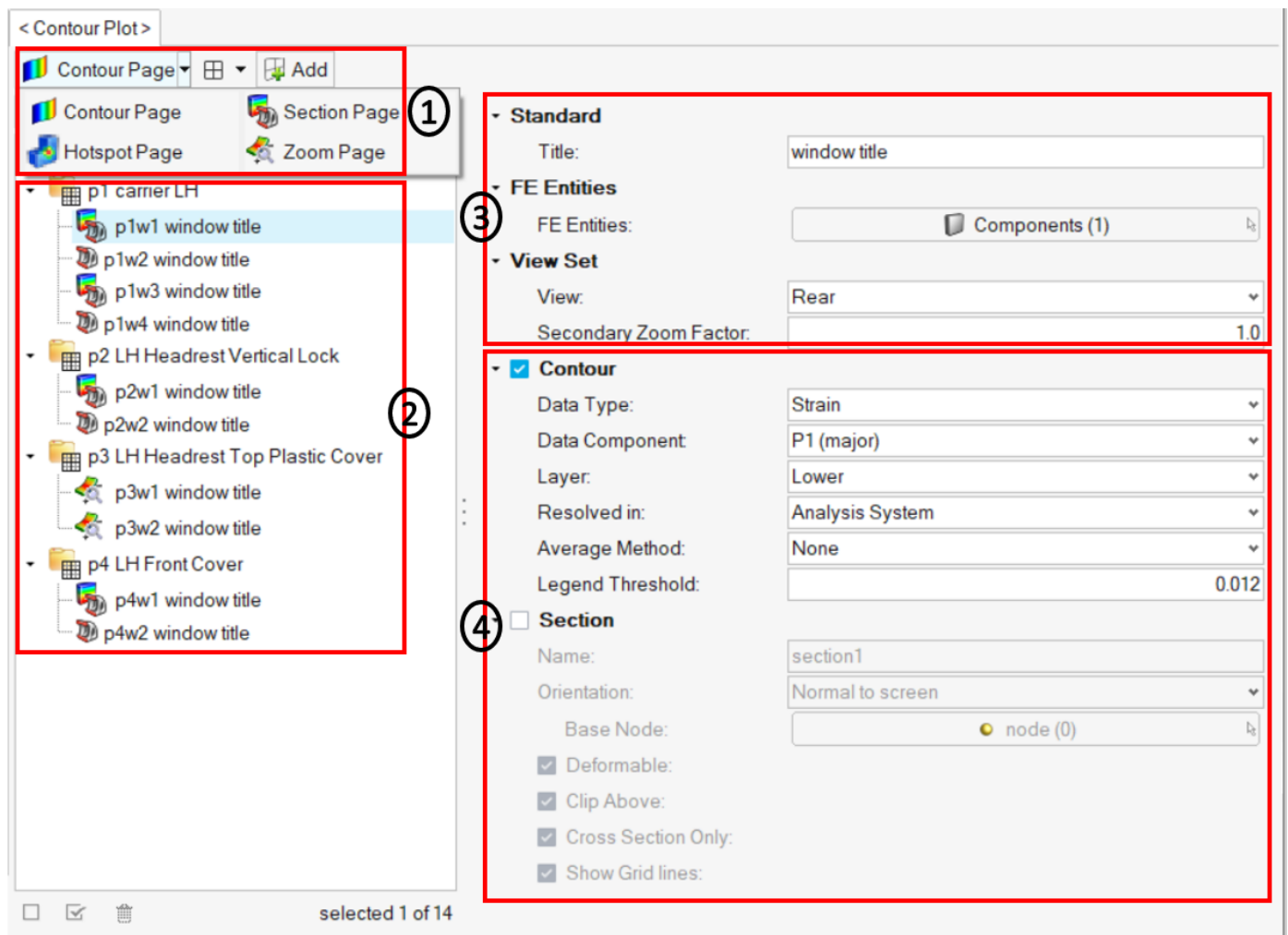


Contour Plot

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.



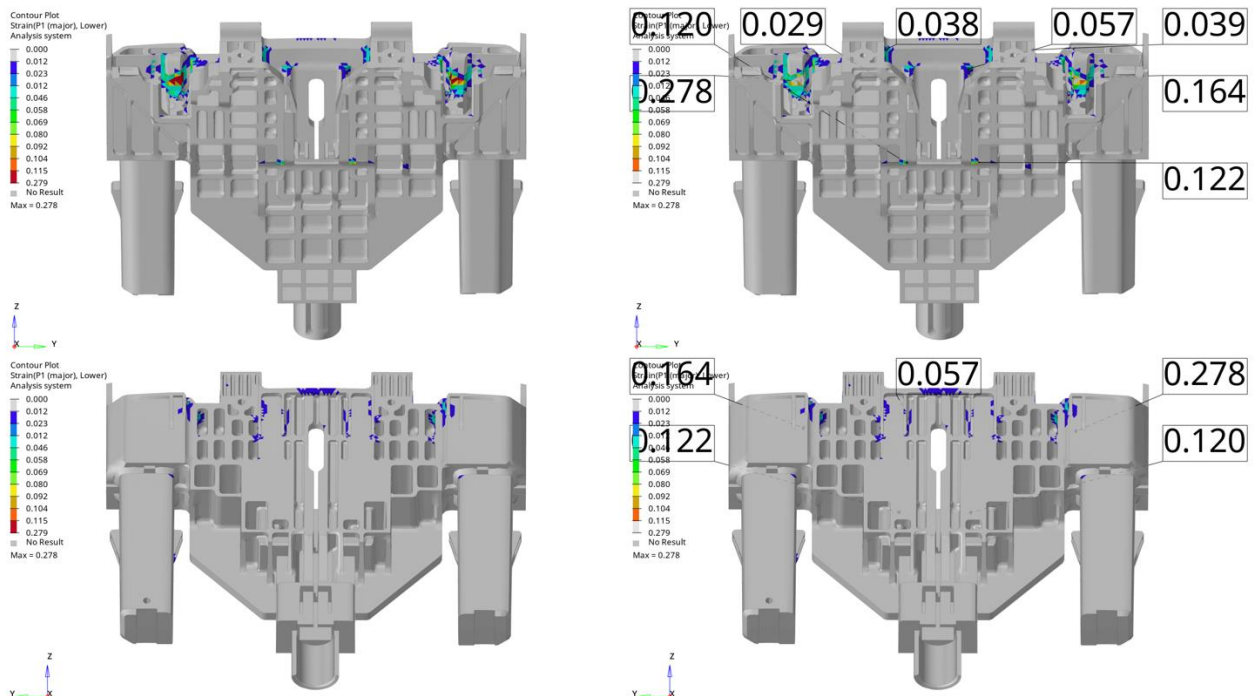
Inputs:

- 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.

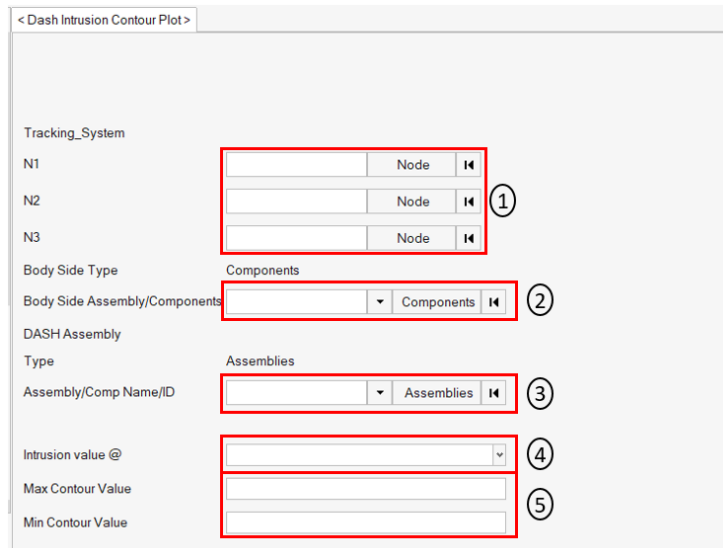
- 2) The **Entity** list browser is used to list and manage the pages included by the user and their respective layouts.
- 3) Enter the **Title** used for the slide title in the report, select the **Components** to be used for the current page type selected and the **View Set** to be used to orient the 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

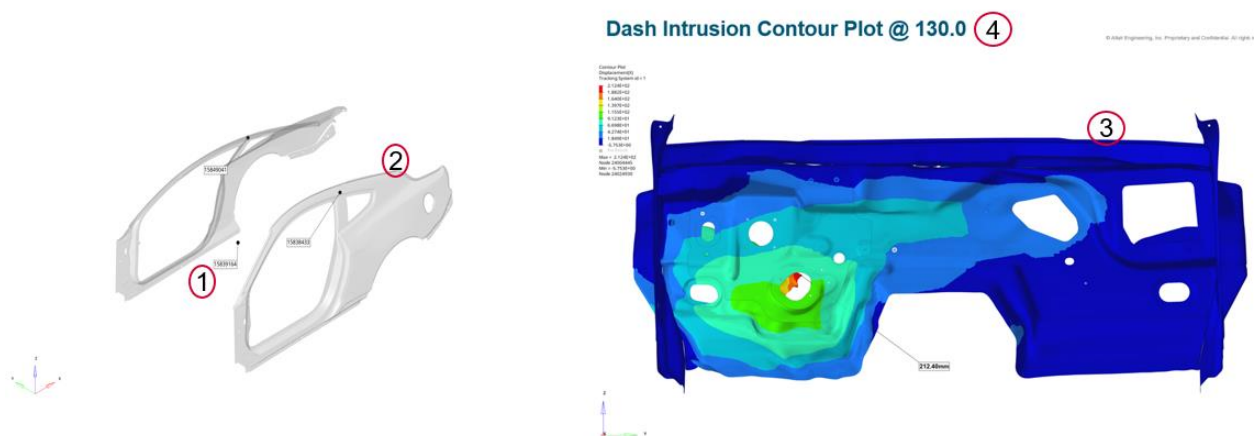
This module generates an overview of Dash Intrusion. Based on the inputs entered, it applies X displacement contour (relative to a fixed coordinate system) on the DASH assembly and finds the node ID with the max intrusion.



Inputs:

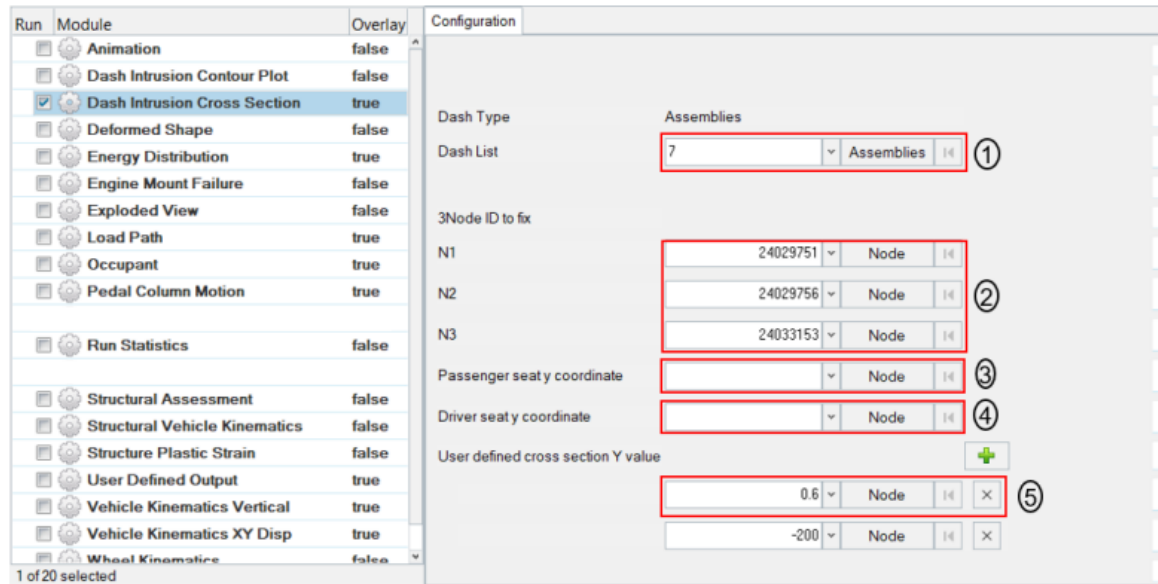
- 1) Node IDs 1, 2 & 3 for defining the tracking system
- 2) Body side assembly IDs used to capture the tracking system nodes
- 3) DASH assembly ID required for plotting Dash Intrusion contour plot
- 4) The step at which intrusion value is calculated. It is either the last step or the step at which max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

Output report:



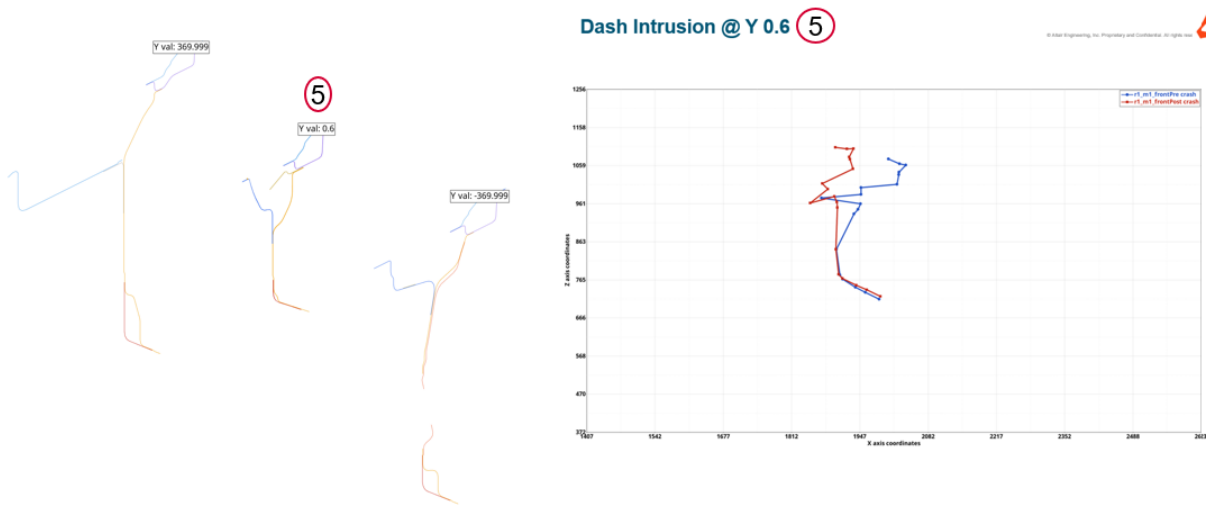
Dash Intrusion Cross Section

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



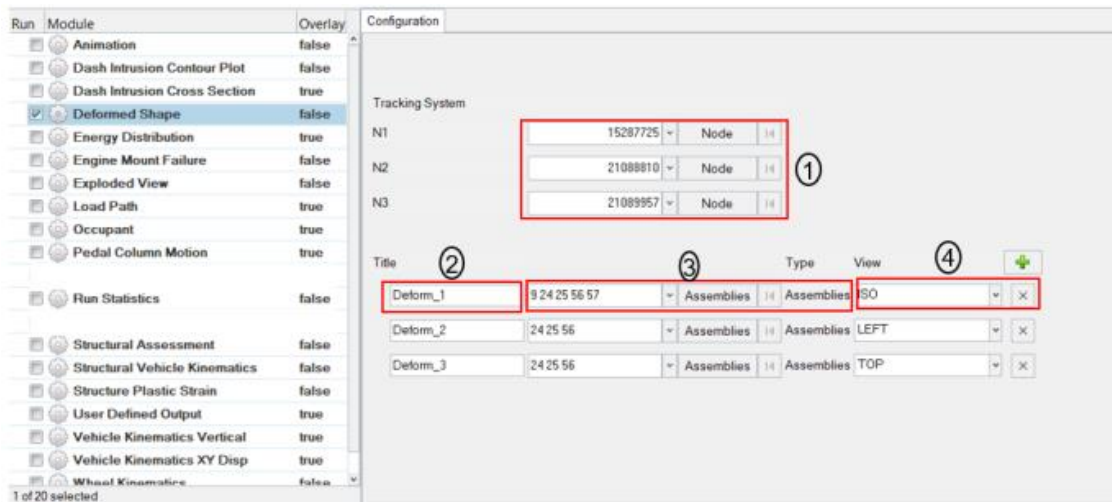
Inputs:

- 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

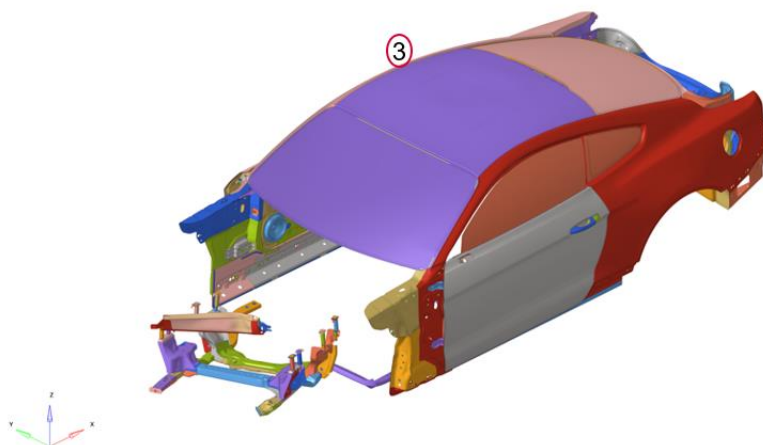
This module is used to create deformed shape of the user selected part sets (components or assemblies) in standard views (Left, Right, Top, Bottom, Front, Rear & Isometric views)



Inputs:

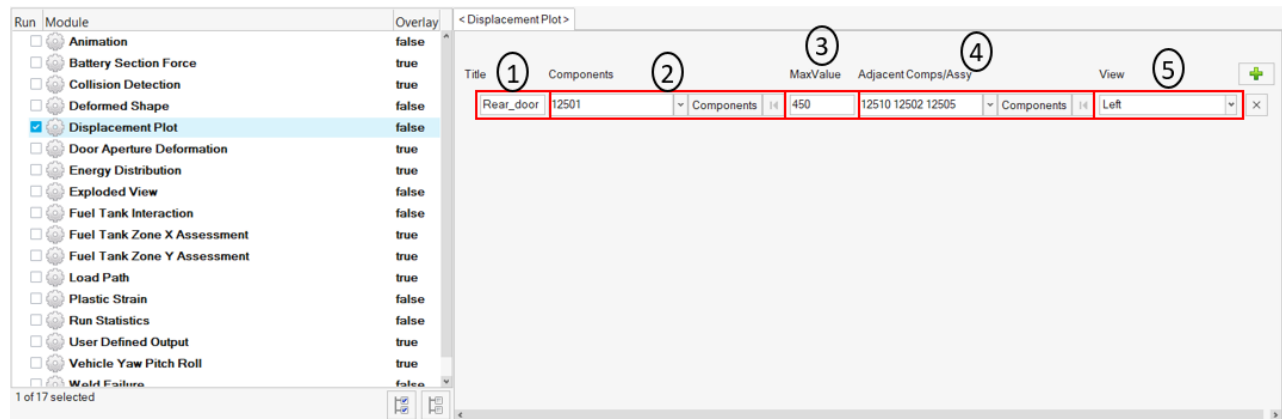
- 1) Node ID 1, 2 & 3 for defining tracking system
- 2) Label to be used for the slide title
- 3) Assembly IDs that will be considered for deformed shape
- 4) The view to be used for deformed shape image capture

Deformed Shape – Deform_1_ISO



Displacement Plot

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

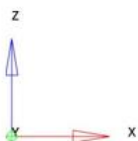
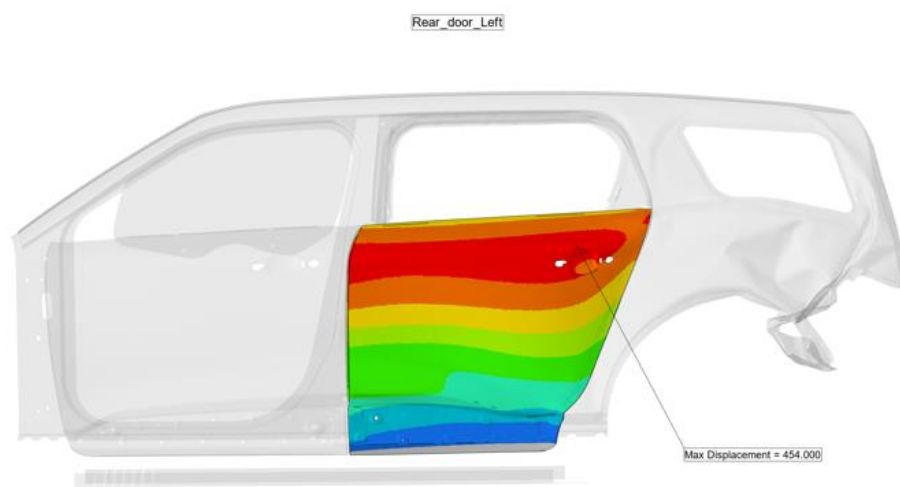


Inputs:

- 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

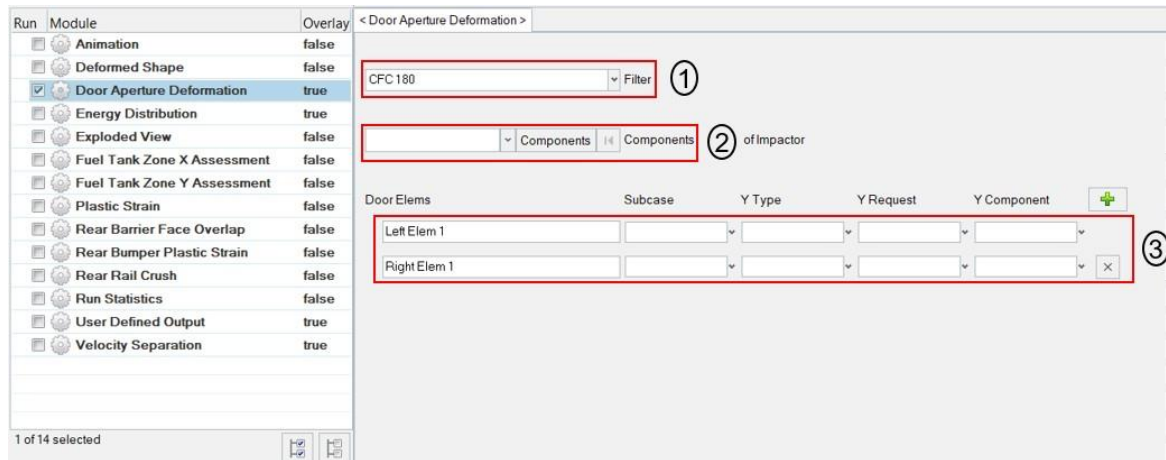
Contour Plot
Displacement(Mag, Mid)
Analysis system
Simple Average

4.54E+02
4.53E+02
4.52E+02
4.50E+02
4.49E+02
4.48E+02
4.47E+02
4.46E+02
4.44E+02
4.43E+02
No Result
Max = 4.54E+02
Node 21044633



Door Aperture Deformation

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



Run	Module	Overlay
	Animation	false
	Deformed Shape	false
	Door Aperture Deformation	true
	Energy Distribution	true
	Exploded View	false
	Fuel Tank Zone X Assessment	false
	Fuel Tank Zone Y Assessment	false
	Plastic Strain	false
	Rear Barrier Face Overlap	false
	Rear Bumper Plastic Strain	false
	Rear Rail Crush	false
	Run Statistics	false
	User Defined Output	true
	Velocity Separation	true

1 of 14 selected

< Door Aperture Deformation >

CFC 180 Filter ①

Components Components ② of Impactor

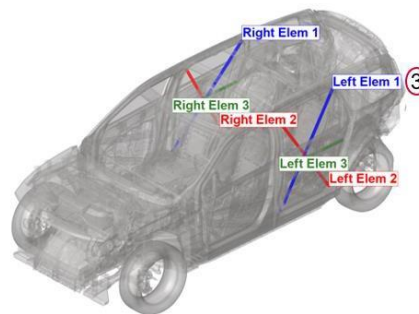
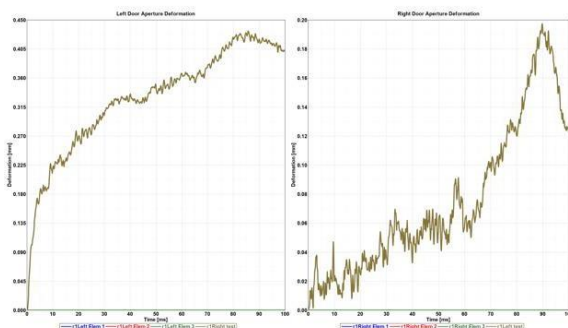
Door Elems	Subcase	Y Type	Y Request	Y Component
Left Elem 1				
Right Elem 1				

③

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

Left Door Aperture		Right Door Aperture	
Title	Peak Deformation [mm]	Title	Peak Deformation [mm]
Left Elem 1	0.00	Right Elem 1	0.00
Left Elem 2	0.00	Right Elem 2	0.00
Left Elem 3	0.00	Right Elem 3	0.00
Right test	0.43	Left test	0.20

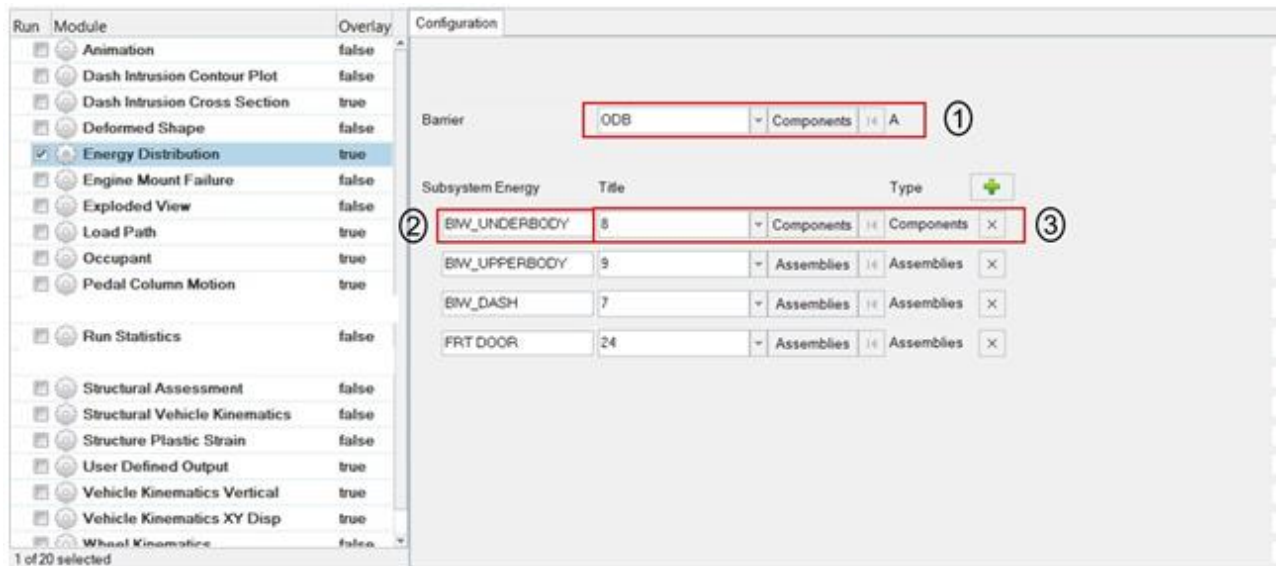


Energy Distribution

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.

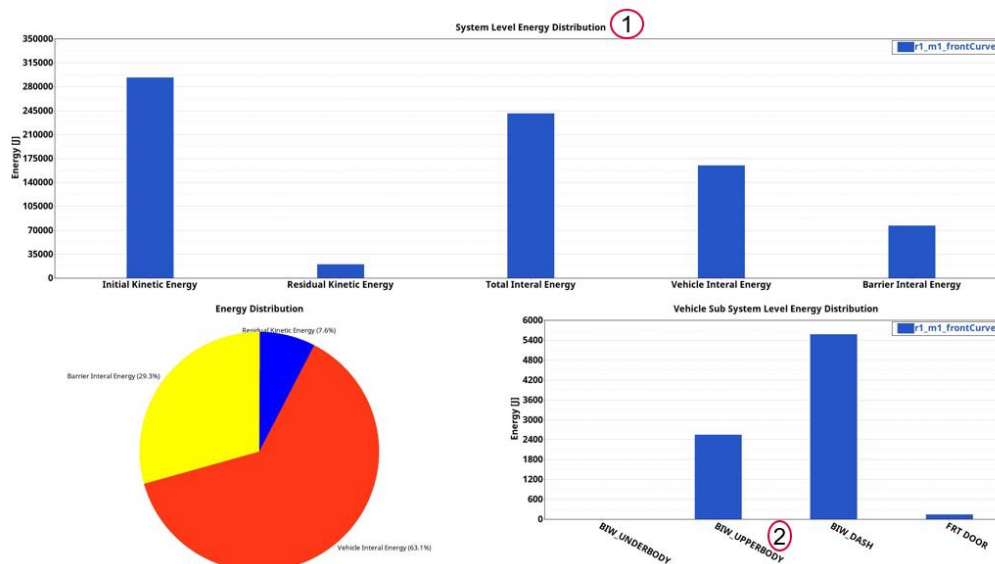
For the barrier, energy plots are created for Initial kinetic energy, residual kinetic energy, total internal energy, vehicle internal energy and barrier internal energy.

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



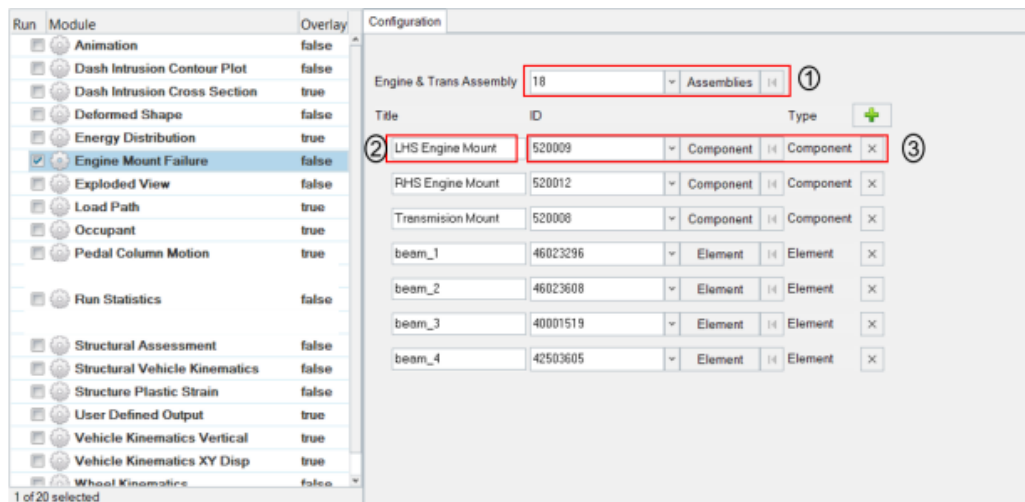
Inputs:

- 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.



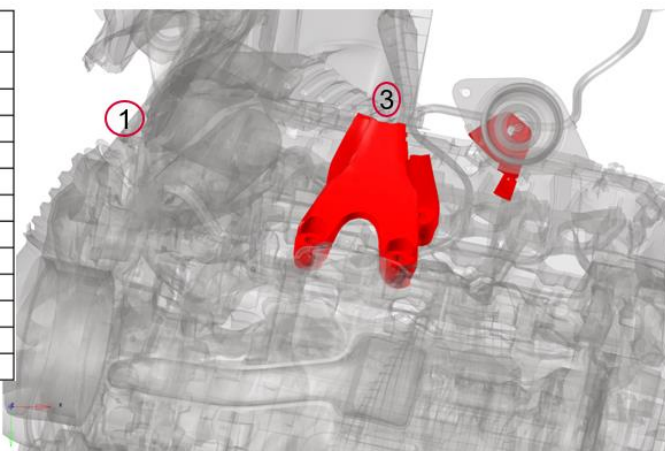
Inputs:

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

LHS Engine Mount (ID: 520009)

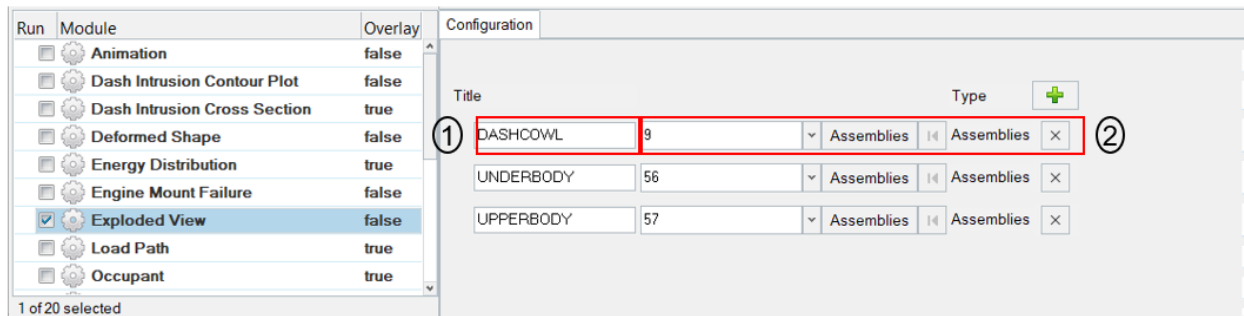
Separation time	55.0
-----------------	------

Title	Comp/Beam	ID	Separation Time
LHS Engine Mount ②	Solid	520009	55.0
RHS Engine Mount	Solid	520012	Intact
Transmission 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



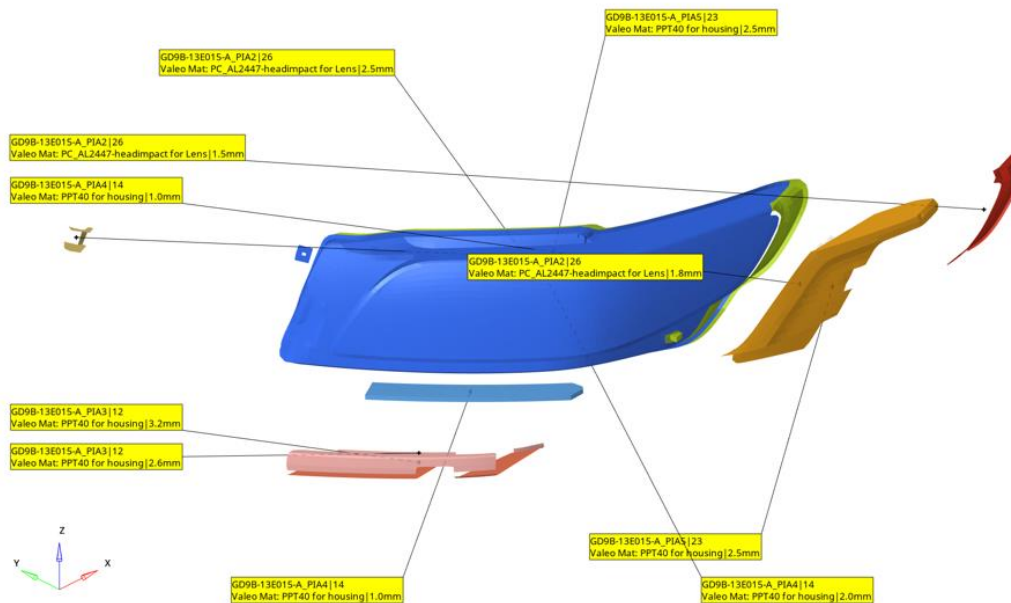
Exploded View

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.



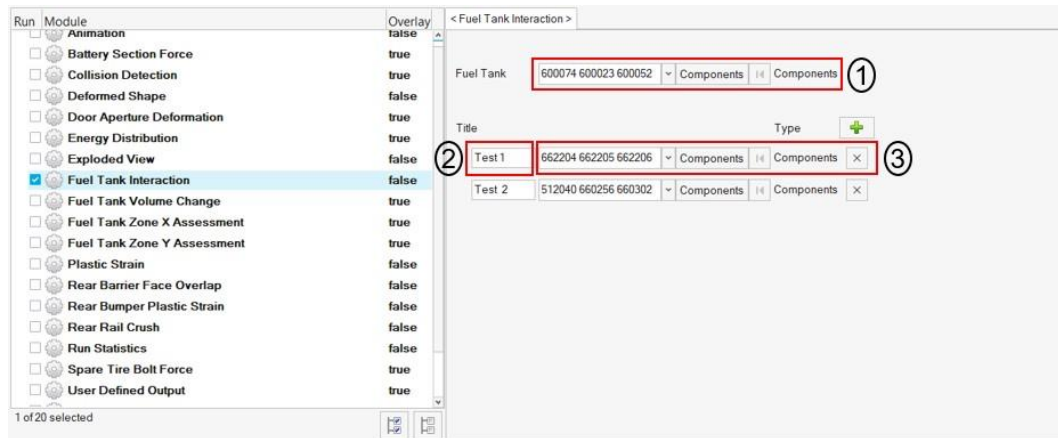
Inputs:

- 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.

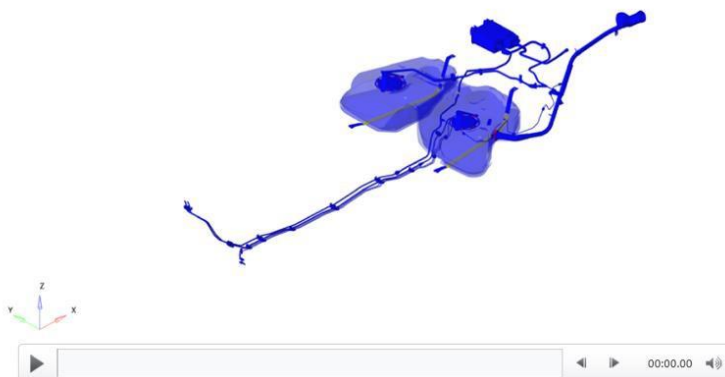


Inputs:

- 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

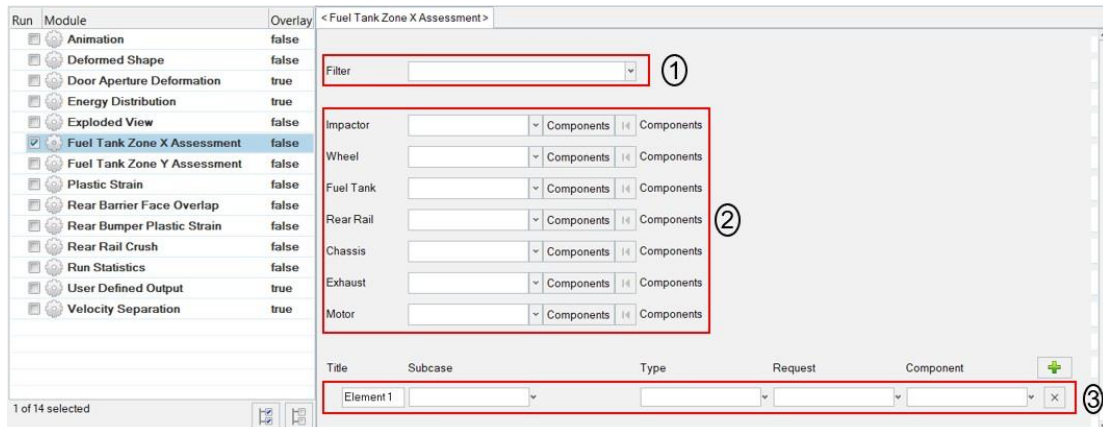
Output report:

Test 1



Fuel Tank Zone X Assessment

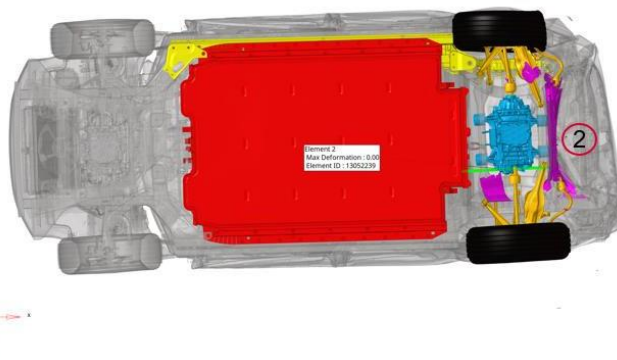
This module is used to evaluate the deformation of fuel tank zone spring elements. It computes the deformation between fuel tank zone cross members along X direction by measuring the spring element deformations.



Inputs:

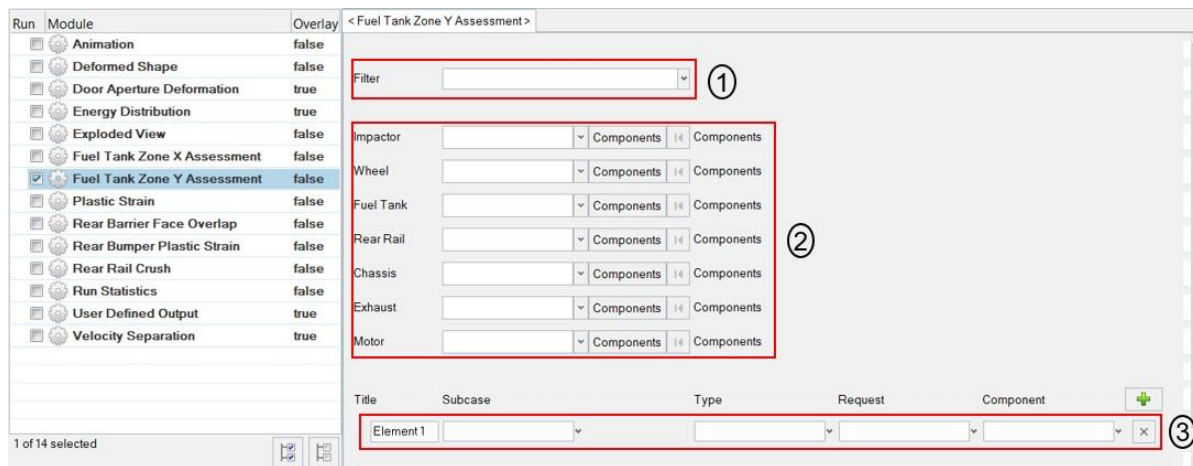
- 1) Filter class to be used if required to filter the deformation curve
- 2) Fuel tank zone cross members comp ID / Assy ID
- 3) The spring element request info (from time history file) for plotting the deformation curves

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



Fuel Tank Zone Y Assessment

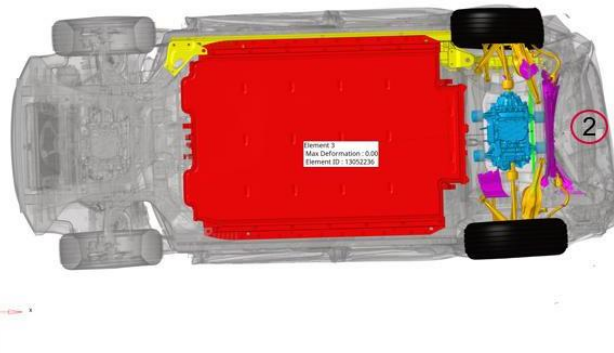
This module is used to evaluate the deformation of fuel tank zone spring elements. It computes the deformation between fuel tank zone cross members along Y direction by measuring the spring element deformations.



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

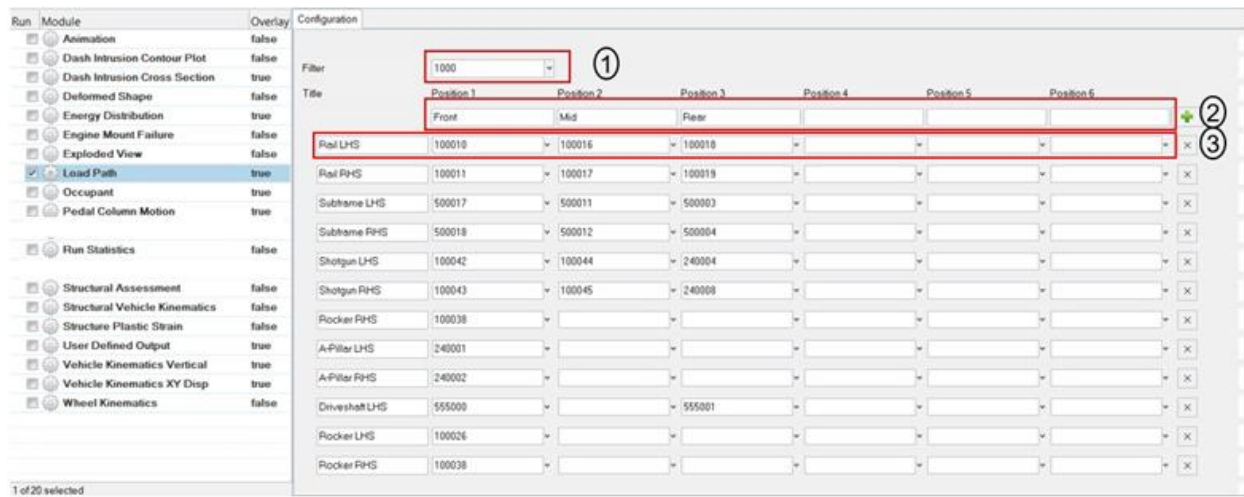
Fuel Tank Zone Y Assessment	
Title	Peak Deformation
Element 1	0.00
Element 2	0.00
Element 3	0.00



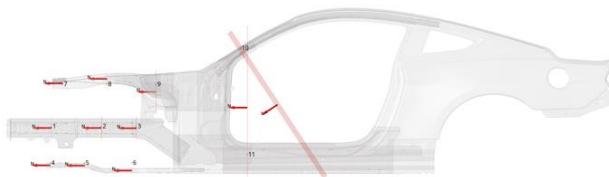
Load Path

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

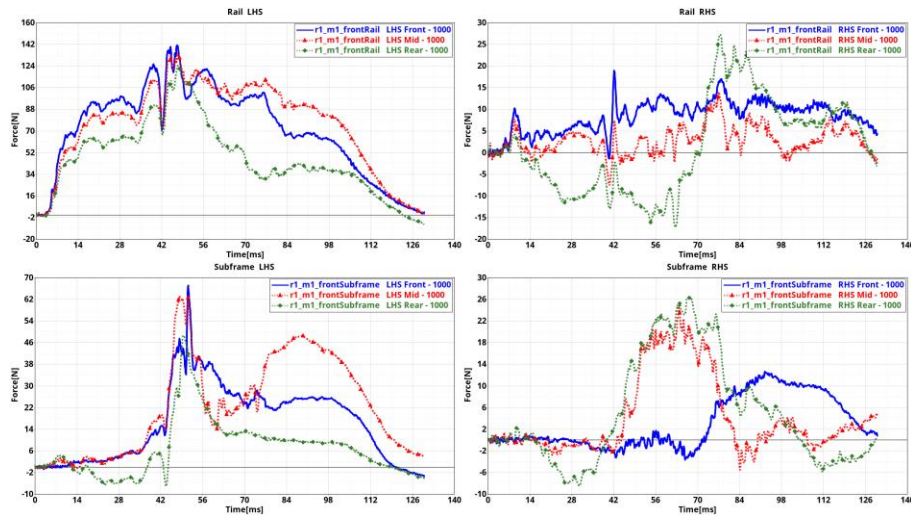


1	Rail Front
2	Rail Mid
3	Rail Rear
4	Subframe Front
5	Subframe Mid
6	Subframe Rear
7	Shotgun Front
8	Shotgun Mid
9	Shotgun Rear
10	A-Pillar Front
11	Rocker Front

Load Path Summary

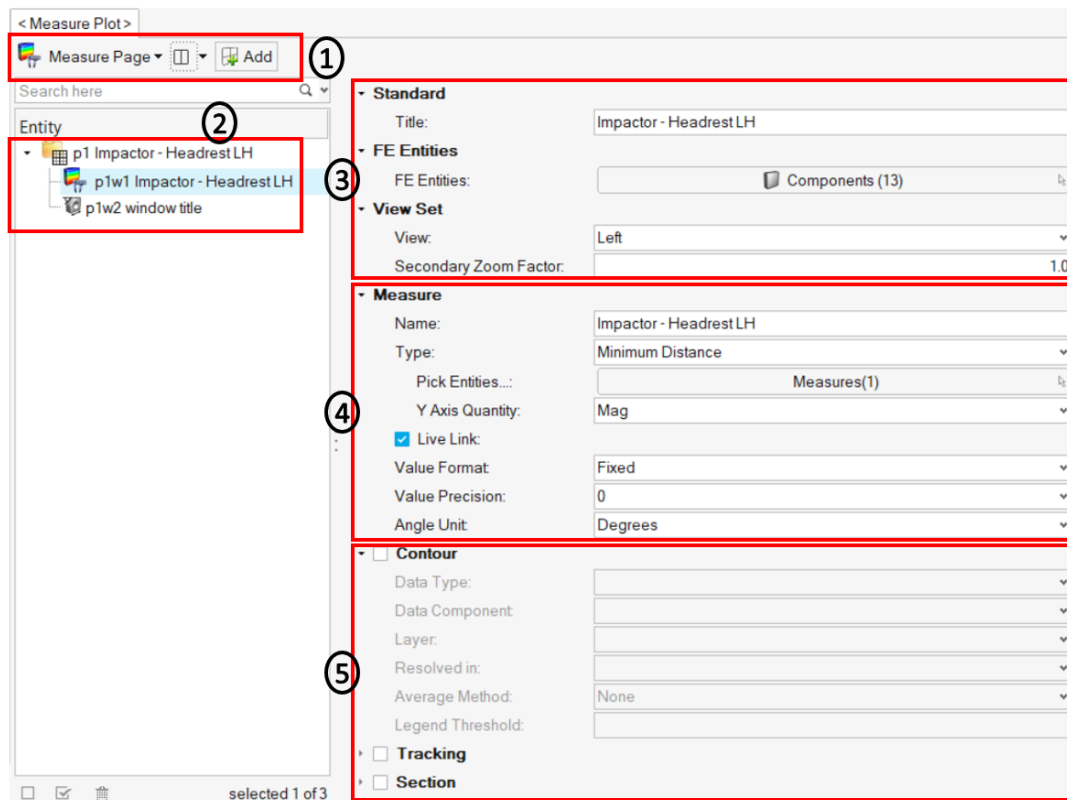
#	Title	Peak Load [LHS] (KN)	Area (mm ²)	Ix (mm ⁴)	Iy (mm ⁴)	J (mm ⁴)	Sx (mm ³)	Sy (mm ³)	Peak Load [RHS] (KN)	Area (mm ²)	Ix (mm ⁴)	Iy (mm ⁴)	J (mm ⁴)	Sx (mm ³)	Sy (mm ³)
r1_m1_front															
1	Rail Front	141.00	38.37	178846.17	51224.93	-43216.83	847.13	693.77	18.93	38.37	16516.83	51224.92	-45234.58	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	18420.61	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	21570.98	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	97954.51	904324.39	999808.24	12426.70	3454.34

Cross Section Force Plot



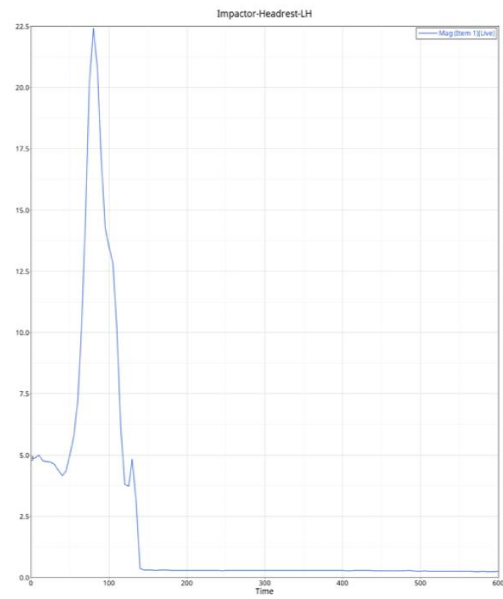
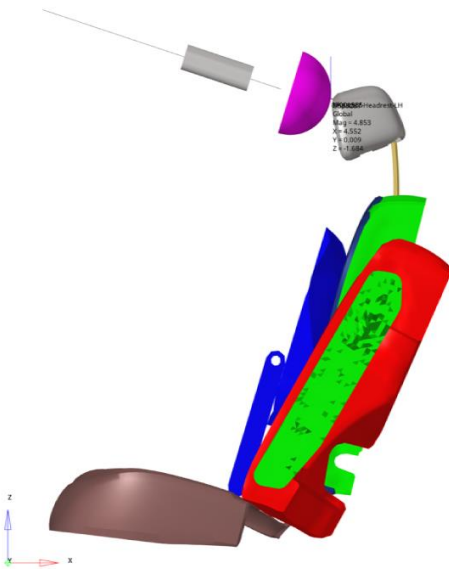
Measure Plot

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.

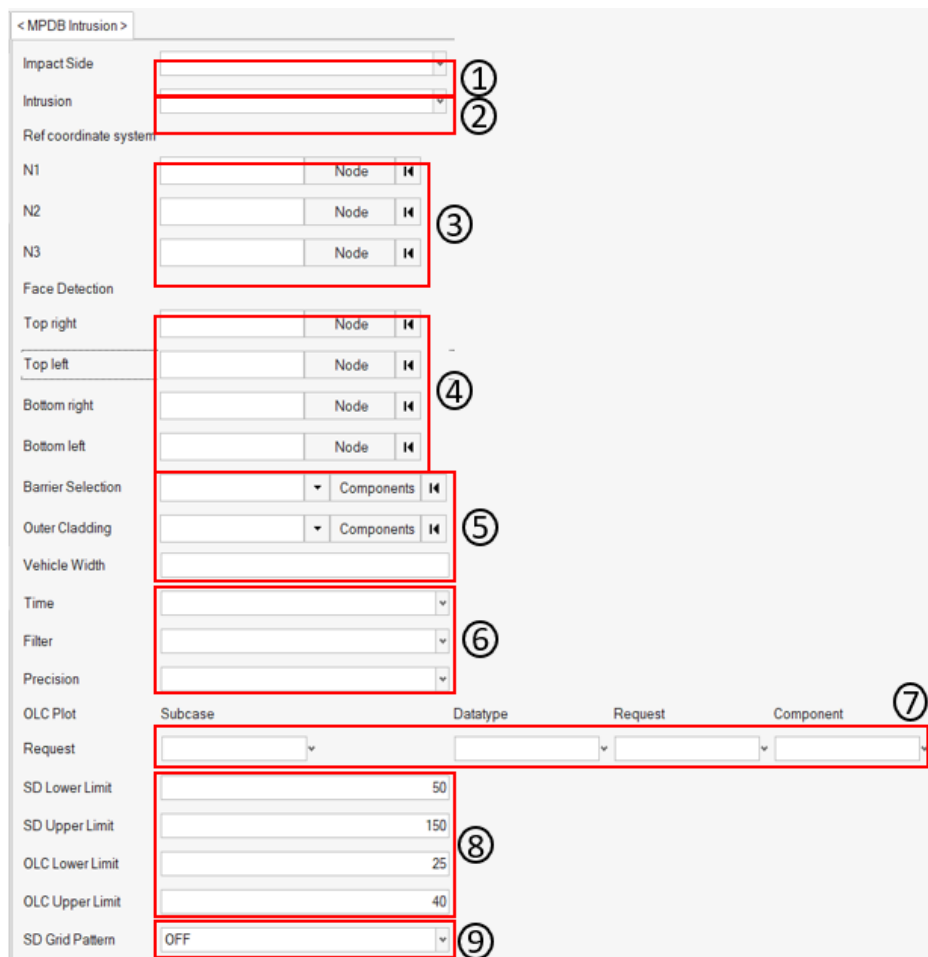


MPDB Intrusion

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



The screenshot shows the MPDB Intrusion software interface. The interface is divided into several sections with input fields. Red boxes and numbered callouts (1-9) highlight specific input areas:

- 1**: Impact Side dropdown menu.
- 2**: Intrusion dropdown menu.
- 3**: Node selection fields for N1, N2, and N3.
- 4**: Node selection fields for Face Detection (Top right, Top left, Bottom right, Bottom left).
- 5**: Barrier Selection and Outer Cladding dropdown menus.
- 6**: Time, Filter, and Precision dropdown menus.
- 7**: OLC Plot table headers (Subcase, Datatype, Request, Component).
- 8**: SD Lower Limit, SD Upper Limit, OLC Lower Limit, and OLC Upper Limit input fields.
- 9**: SD Grid Pattern dropdown menu.

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 $\leq 0.1\%$; 1 means $\leq 0.001\%$)
- 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:

Standard Deviation Calculation

Contour Plot
Node_values(0)

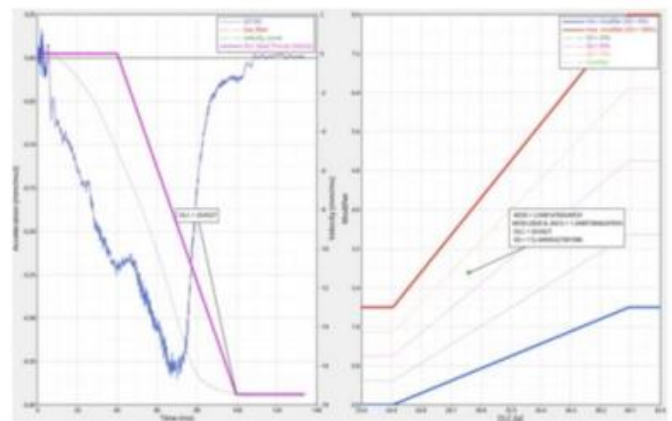
600.000
480.000
320.000
160.000
0.000

No Results

Max = 451.000
Node 5001
Min = -2.784
Node 6354



Intrusion Timestep	1.160.000
Intrusion Index	27
Vehicle Width	1850
SD Value	153.25
OLC Value	0.00
Modifier Value	-0.09
No. of Buffering out Cells (>400mm)	0



GRID projection

Contour Plot
Element_values(Scalar value)

600.000

480.000

320.000

160.000

0.000

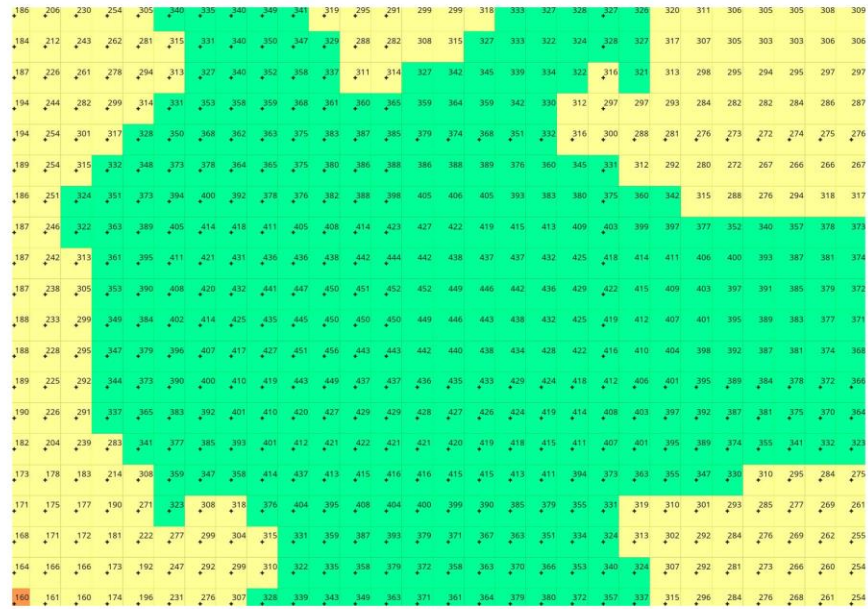
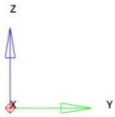
No Result

Max = 456.492

SHELL 950588881

Min = 150.891

SHELL 950588963

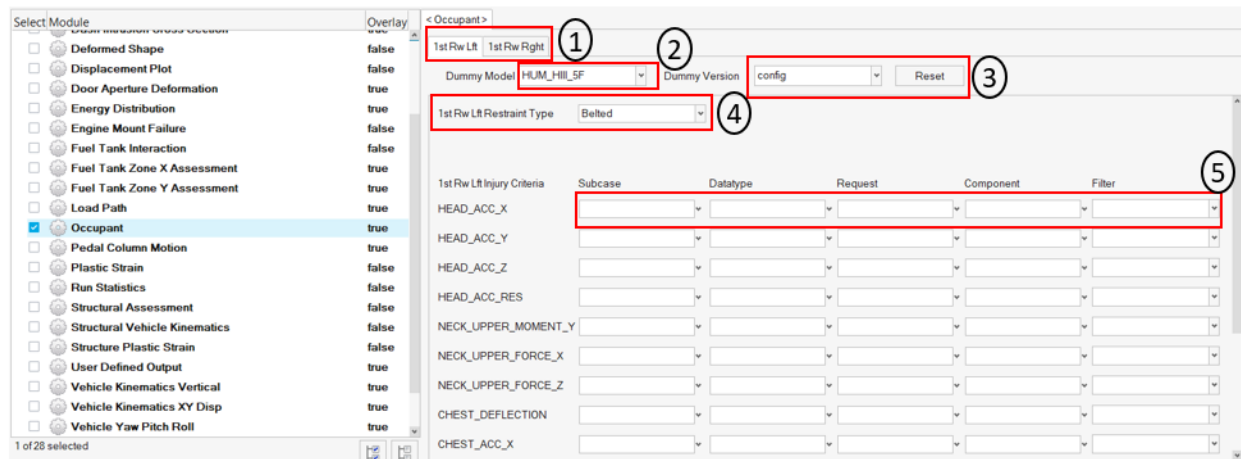


Occupant

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 it 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.

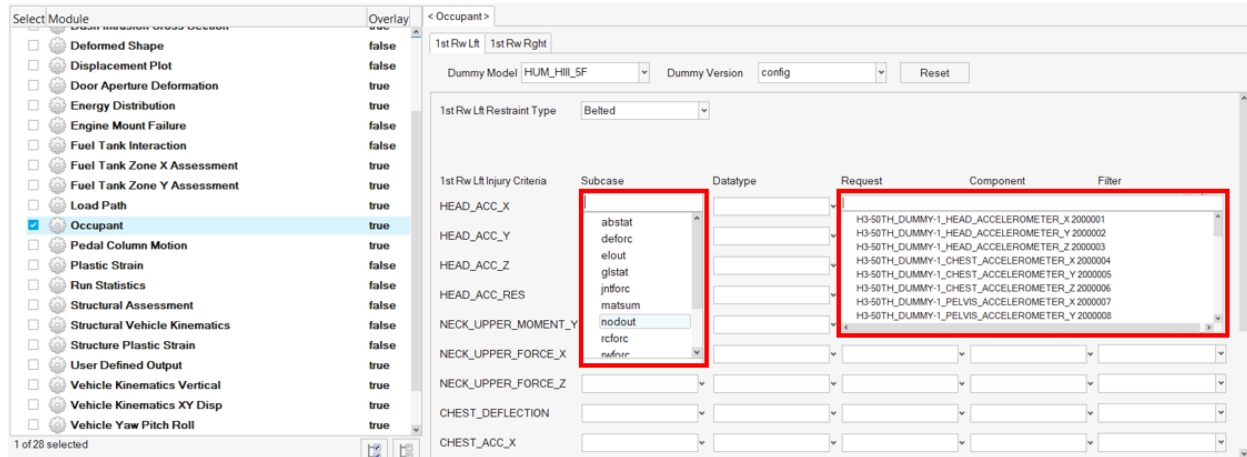


Inputs:

- 1) **Tags** 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:

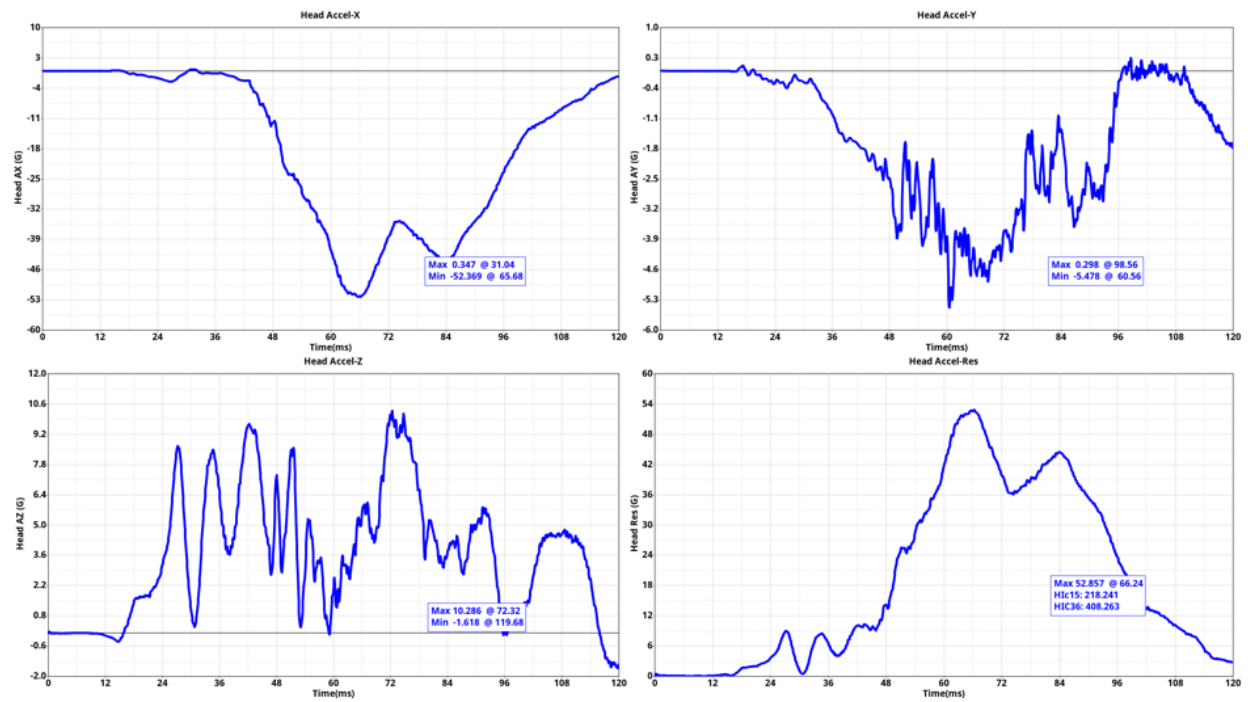
In addition to above inputs, there is **1st Rw Lft ID & 1st Rw Right ID**. This option is enabled or used only when the dummy version is set to anything other than config. This is needed by the tool so it can differentiate between driver & passenger request IDs when plotting the occupant injury curves.



Occupant Summary

Occupant	1st Rw Lft	Internal	1st Rw Right	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

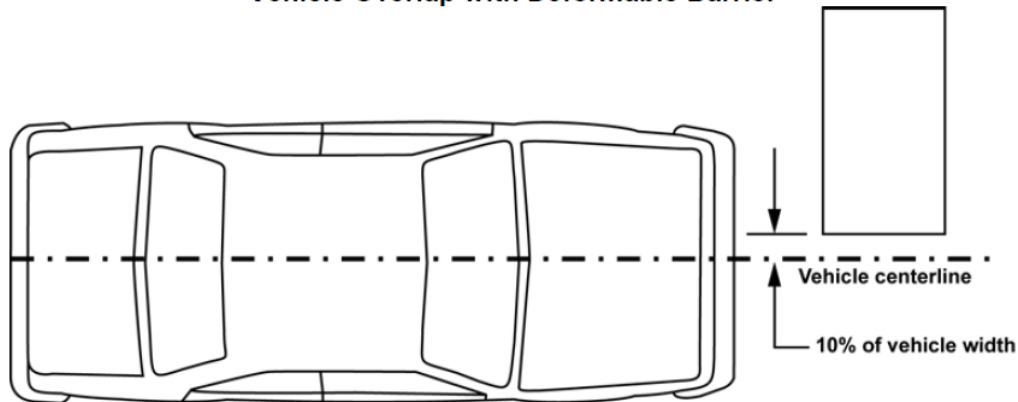
Driver Head Acceleration



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 $10 \pm 1\%$ of the vehicle width as shown below.

Vehicle Overlap with Deformable Barrier



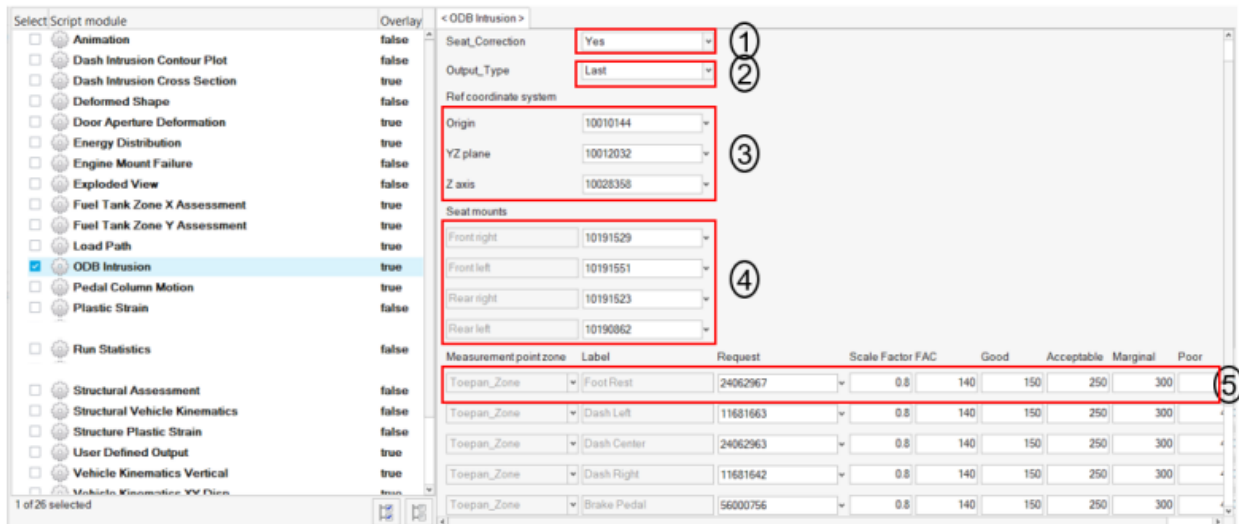
A total of 14 measurement locations are used in general (on the driver-side interior & exterior of the vehicle) and their longitudinal, lateral & vertical displacements with respect to a user defined coordinate system are measured.

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).

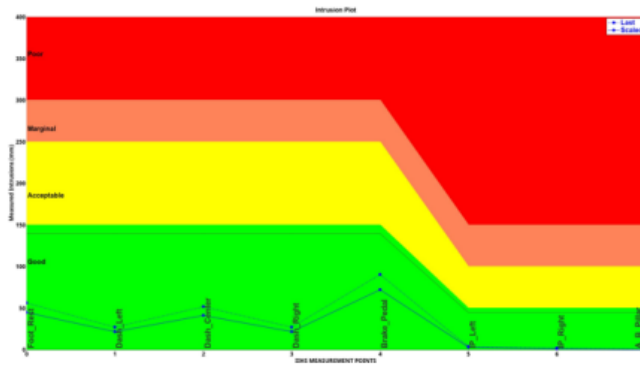
In addition, user can enter the scale factor along with the criteria values. User can also enter as many additional measurement locations as needed.



Measurement point zone	Label	Request	Scale Factor FAC	Good	Acceptable	Marginal	Poor
ToePan_Zone	Foot Rest	24062967	0.8	140	150	250	300
ToePan_Zone	Dash Left	11681663	0.8	140	150	250	300
ToePan_Zone	Dash Center	24062963	0.8	140	150	250	300
ToePan_Zone	Dash Right	11681642	0.8	140	150	250	300
ToePan_Zone	Brake Pedal	56000756	0.8	140	150	250	300

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

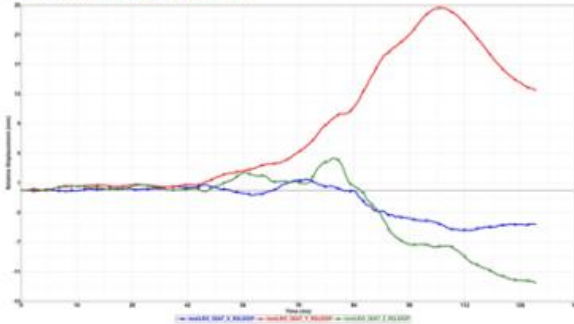
Occupant Kinematics Modifier

Seat Attachment Relative Vert. Displ. ≥ 60 mm	7.8
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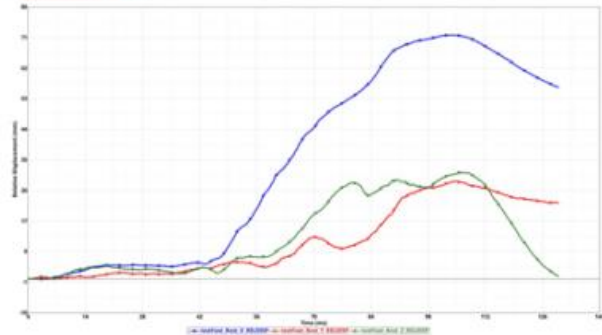
Structure Modifiers

Structural Integrity	Not Assessed
Fuel/HEV System Integrity	Not Assessed

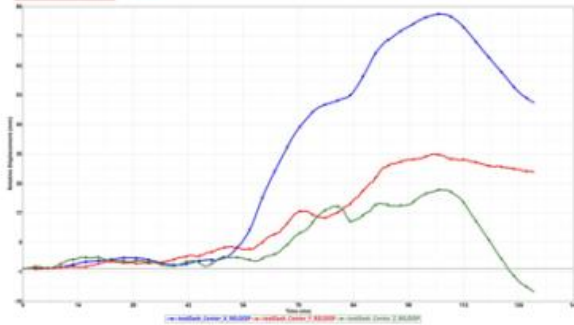
Seat Mount Plots LROSEAT



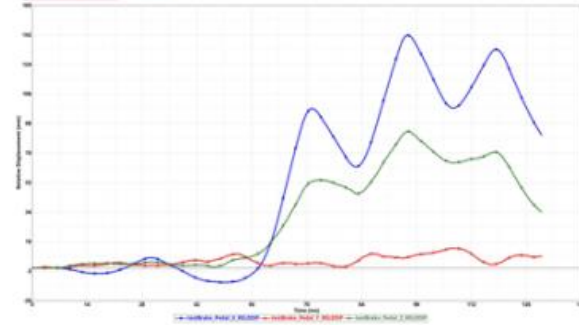
FootRest Plots



DashCenter Plots



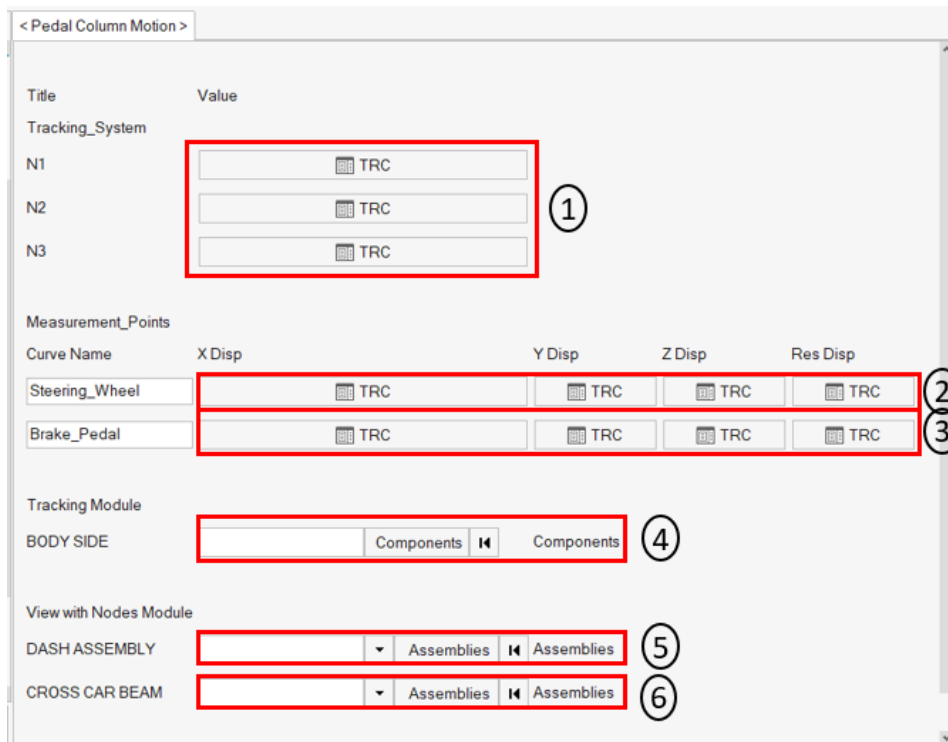
BrakePedal Plots



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



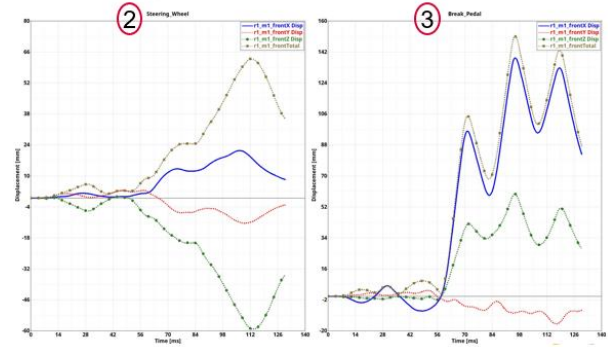
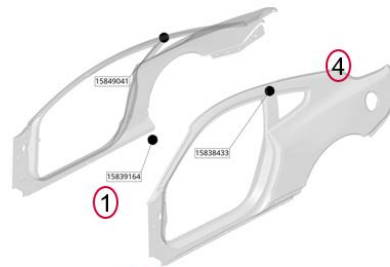
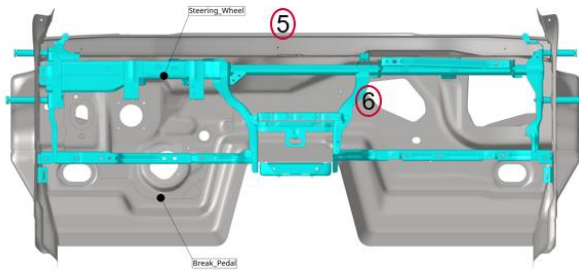
The screenshot shows the 'Pedal Column Motion' software interface. It contains several sections with input fields and buttons, each highlighted with a red box and a numbered callout:

- Tracking_System:** A table with columns 'Title' and 'Value'. It lists N1, N2, and N3. The 'Value' column for each has a 'TRC' button. This entire section is highlighted with a red box and labeled with a circled '1'.
- Measurement_Points:** A table with columns 'Curve Name', 'X Disp', 'Y Disp', 'Z Disp', and 'Res Disp'. It lists 'Steering_Wheel' and 'Brake_Pedal'. Each 'Disp' column has a 'TRC' button. The 'Steering_Wheel' row is highlighted with a red box and labeled with a circled '2'. The 'Brake_Pedal' row is highlighted with a red box and labeled with a circled '3'.
- Tracking Module:** A section with a 'BODY SIDE' label and a text input field. To the right are 'Components' buttons with a double-headed arrow between them. This section is highlighted with a red box and labeled with a circled '4'.
- View with Nodes Module:** A section with two rows: 'DASH ASSEMBLY' and 'CROSS CAR BEAM'. Each row has a dropdown menu, a 'Components' button, and a 'Nodes' button. The 'DASH ASSEMBLY' row is highlighted with a red box and labeled with a circled '5'. The 'CROSS CAR BEAM' row is highlighted with a red box and labeled with a circled '6'.

Inputs:

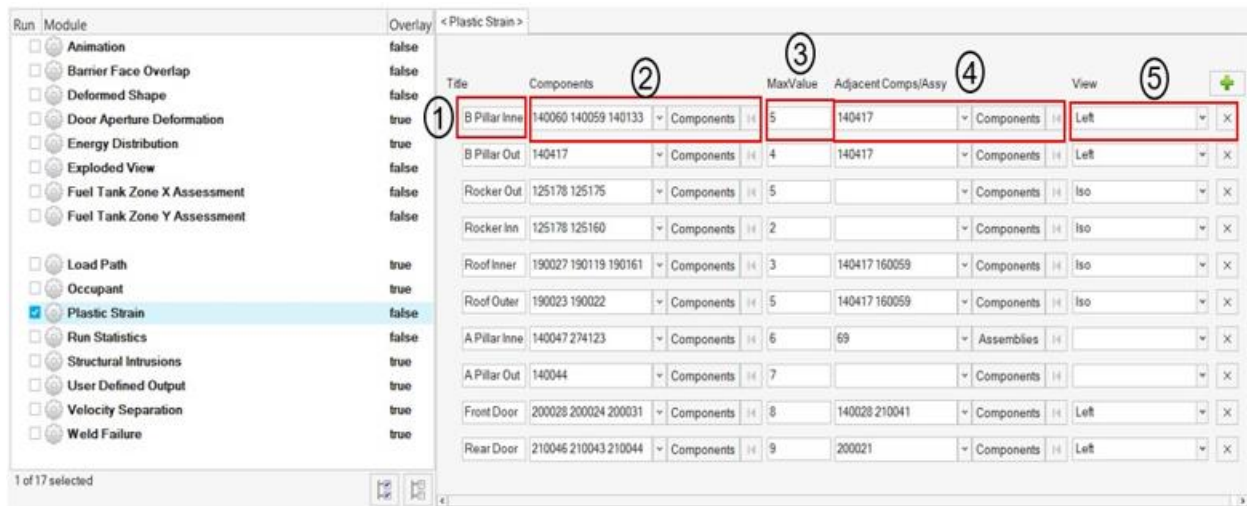
- 1) The 3 nodes N1, N2 & N3 defining tracking system
- 2) The steering column name and the corresponding request ID required for plotting
- 3) The brake pedal name & request ID required for plotting
- 4) The body side component IDs required for capturing tracking system nodes
- 5) DASH assembly ID
-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

	r1_m1_front			
	2	Steering_Wheel	3	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.



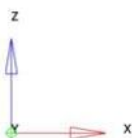
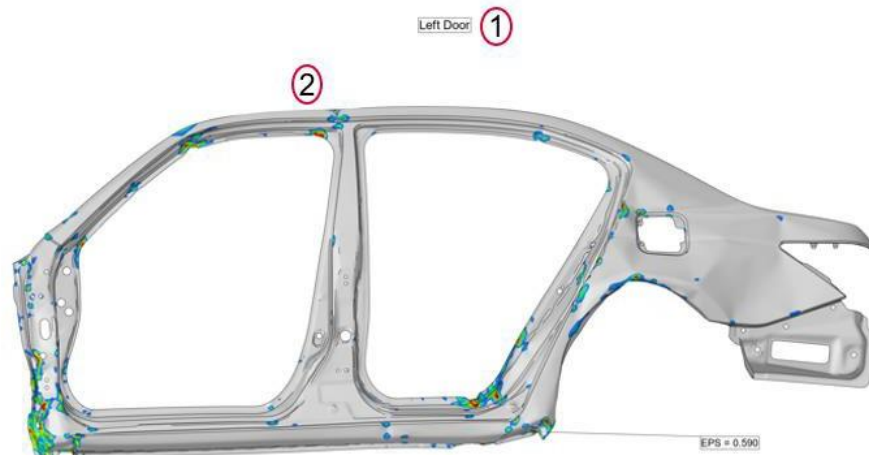
Inputs:

- 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

Contour Plot
Effective plastic strain(Mag, Mid)
Simple Average

5.90E-01
5.00E-02
4.37E-02
3.75E-02
3.13E-02
2.50E-02
1.88E-02
1.25E-02
6.25E-03
0.00E+00
No Result

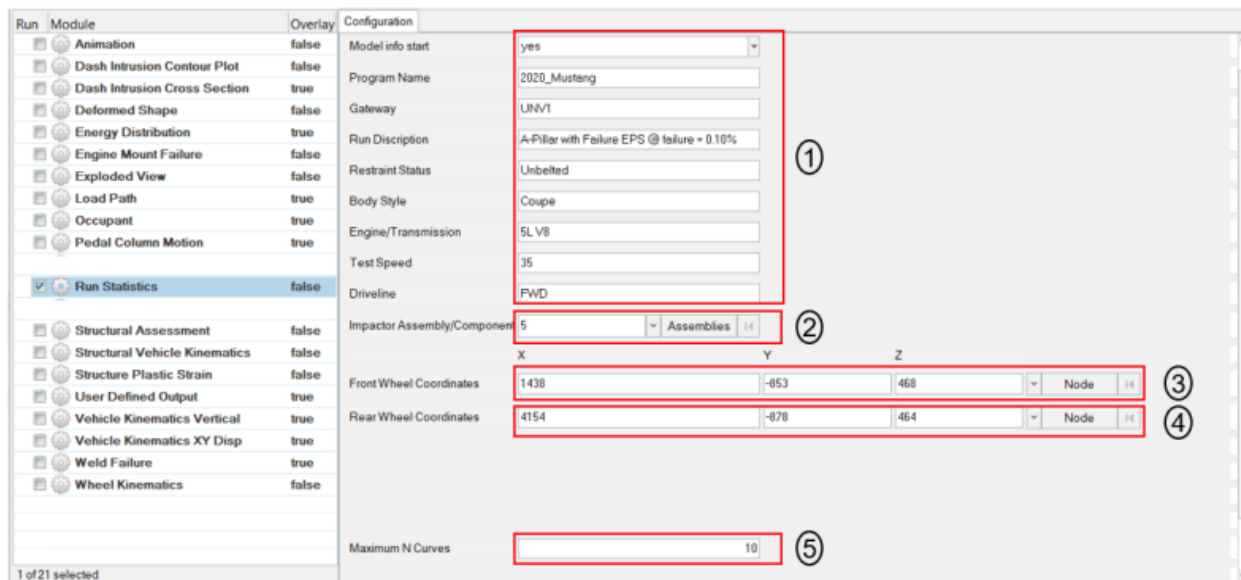
Max = 5.90E-01
Node 2072088



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

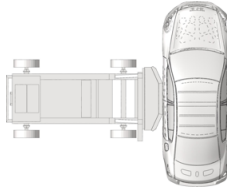


Run	Module	Overlay
<input type="checkbox"/>	Animation	false
<input type="checkbox"/>	Dash Intrusion Contour Plot	false
<input type="checkbox"/>	Dash Intrusion Cross Section	true
<input type="checkbox"/>	Deformed Shape	false
<input type="checkbox"/>	Energy Distribution	true
<input type="checkbox"/>	Engine Mount Failure	false
<input type="checkbox"/>	Exploded View	false
<input type="checkbox"/>	Load Path	true
<input type="checkbox"/>	Occupant	true
<input type="checkbox"/>	Pedal Column Motion	true
<input checked="" type="checkbox"/>	Run Statistics	false
<input type="checkbox"/>	Structural Assessment	false
<input type="checkbox"/>	Structural Vehicle Kinematics	false
<input type="checkbox"/>	Structure Plastic Strain	false
<input type="checkbox"/>	User Defined Output	true
<input type="checkbox"/>	Vehicle Kinematics Vertical	true
<input type="checkbox"/>	Vehicle Kinematics XY Disp	true
<input type="checkbox"/>	Weld Failure	true
<input type="checkbox"/>	Wheel Kinematics	false

Configuration	
Model info start	yes
Program Name	2020_Mustang
Gateway	UNV1
Run Description	A-Pillar with Failure EPS @ failure = 0.10%
Restraint Status	Unbelted
Body Style	Coupe
Engine/Transmission	5L V8
Test Speed	35
Driveline	FWD
Impactor Assembly/Component	5
Front Wheel Coordinates	X: 1438, Y: -853, Z: 468
Rear Wheel Coordinates	X: 4154, Y: -878, Z: 464
Maximum N Curves	10

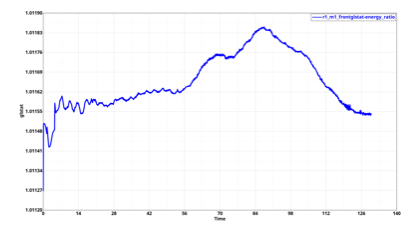
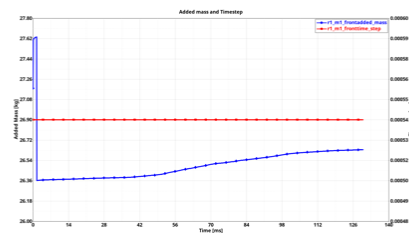
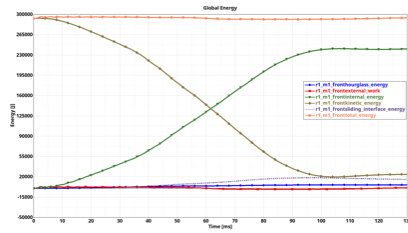
Model Info Summary & Run Quality Report

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



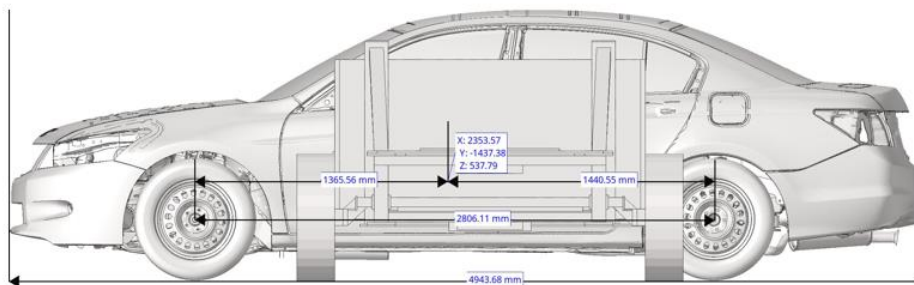
Run Quality	Result	Target
Termination Time	0.2 ms	0.2 ms
Termination Type	Normal Termination	
Mass Added @ T=0 [%]	0.44 %	< 1 %
Total Mass Added [%]	0.96 %	< 3 %
Total Mass Added [kg]	0.03 kg	
Energy -> Hourglass [%]	3.45 %	< 10 %
Energy -> Ratio [%]	1.00 %	1 >= Energy Ratio < 1.01

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



Vehicle Mass & Geometric Measurements

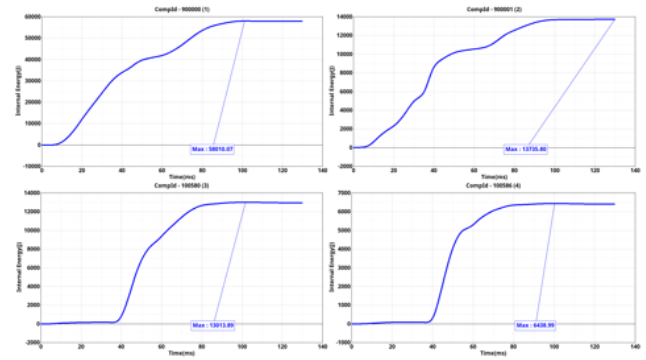
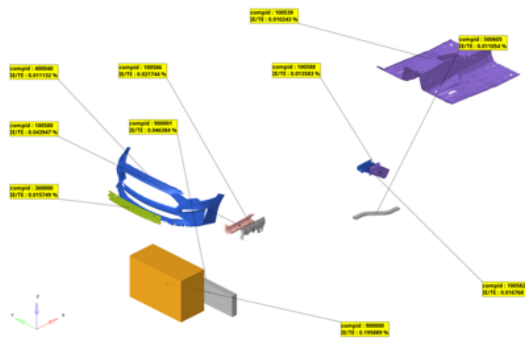
Vehicle Mass (kg)	1826.09 kg
Front Axle weight %	55.67%
Rear Axle weight %	44.33%



Material Internal Energy Summary

Material Internal Energy - Exploded View (Top 10)

© 2008 Engineering, Inc. Private



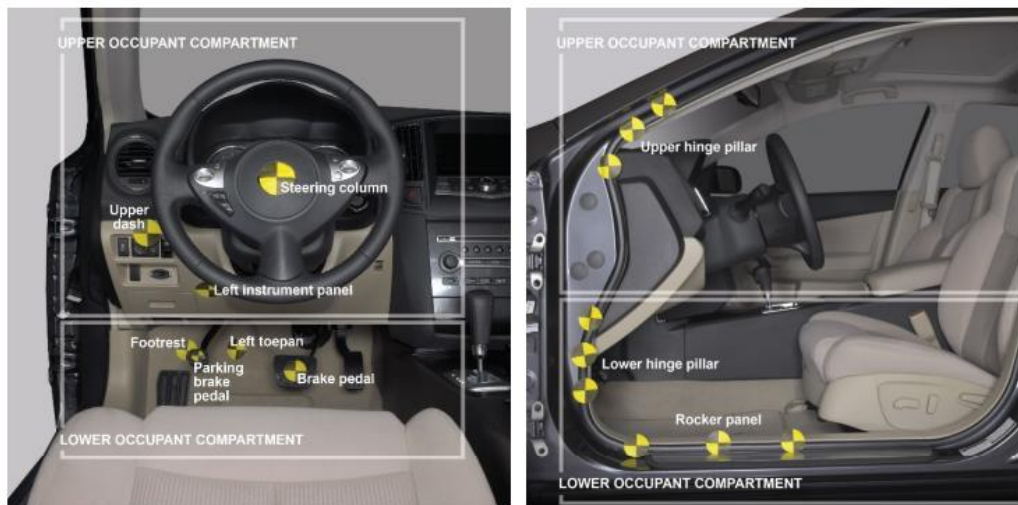
SORB Intrusion

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 $25 \pm 1\%$ 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:



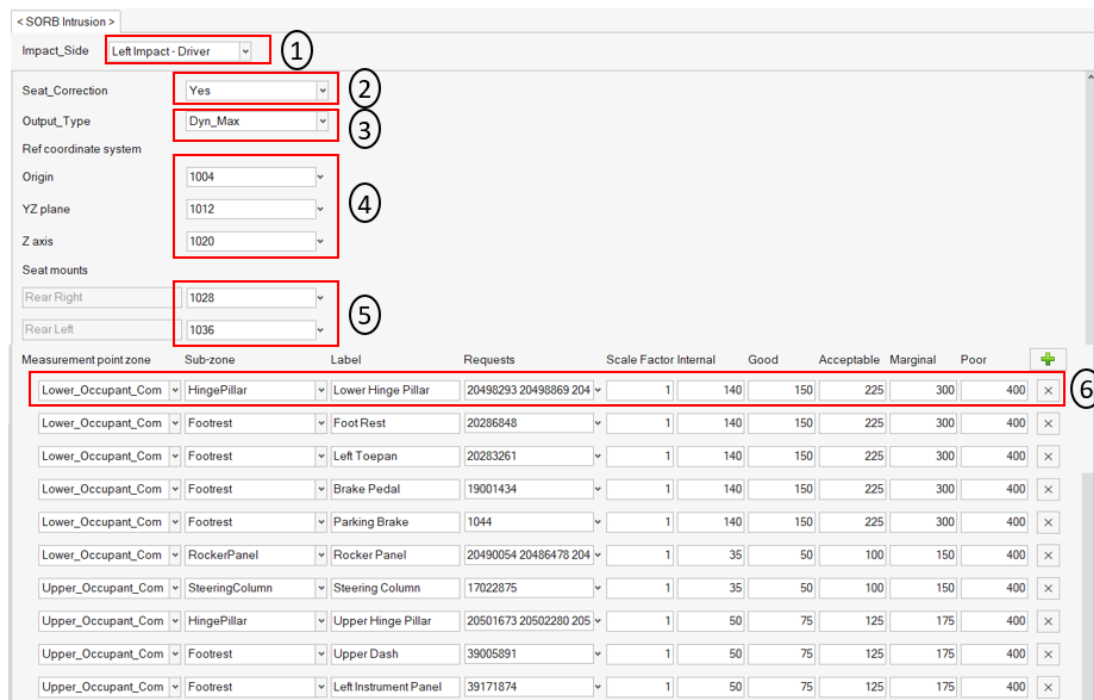
Locations for Measuring Vehicle Intrusion – Passenger side:



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.



< SORB Intrusion >

Impact_Side: Left Impact - Driver (1)

Seat_Correction: Yes (2)

Output_Type: Dyn_Max (3)

Ref coordinate system

Origin: 1004

YZ plane: 1012 (4)

Z axis: 1020

Seat mounts

Rear Right: 1028 (5)

Rear Left: 1036

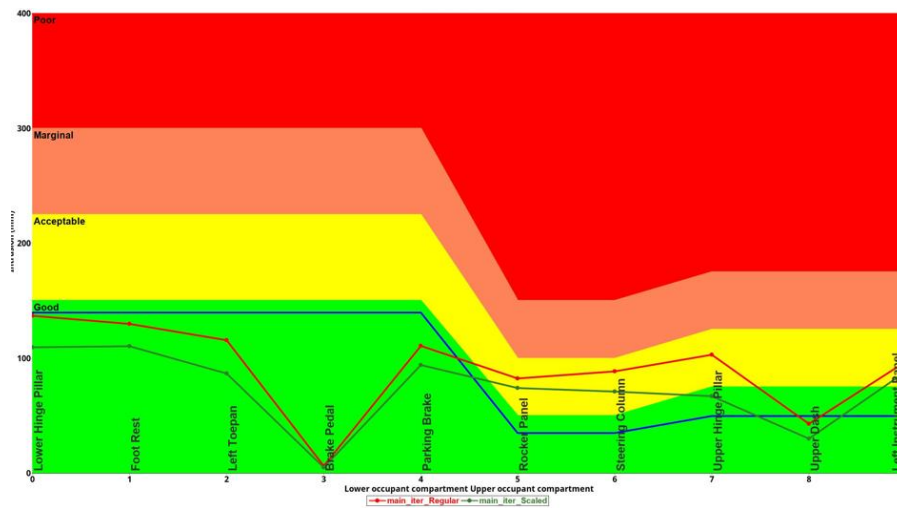
Measurement point zone	Sub-zone	Label	Requests	Scale Factor	Internal	Good	Acceptable	Marginal	Poor	
Lower_Occupant_Com	HingePillar	Lower Hinge Pillar	20498293 20498869 204	1	140	150	225	300	400	x (6)
Lower_Occupant_Com	Footrest	Foot Rest	20286848	1	140	150	225	300	400	x
Lower_Occupant_Com	Footrest	Left Toe pan	20283261	1	140	150	225	300	400	x
Lower_Occupant_Com	Footrest	Brake Pedal	19001434	1	140	150	225	300	400	x
Lower_Occupant_Com	Footrest	Parking Brake	1044	1	140	150	225	300	400	x
Lower_Occupant_Com	RockerPanel	Rocker Panel	20490054 20486478 204	1	35	50	100	150	400	x
Upper_Occupant_Com	SteeringColumn	Steering Column	17022875	1	35	50	100	150	400	x
Upper_Occupant_Com	HingePillar	Upper Hinge Pillar	20501673 20502280 205	1	50	75	125	175	400	x
Upper_Occupant_Com	Footrest	Upper Dash	39005891	1	50	75	125	175	400	x
Upper_Occupant_Com	Footrest	Left Instrument Panel	39171874	1	50	75	125	175	400	x

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 Toe Pan	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

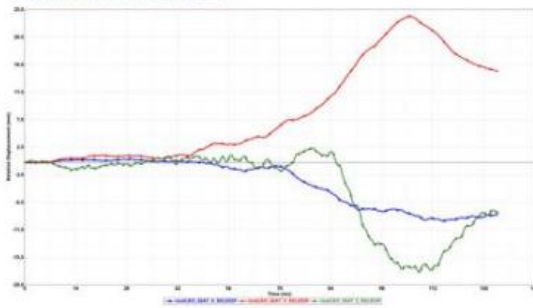
Structural Integrity	Not Assessed
Fuel/HEV System Integrity	Not Assessed

SORB Rating

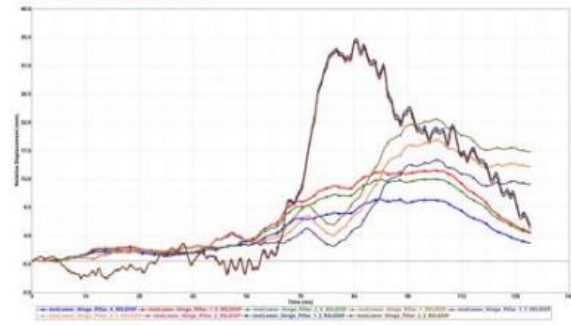
Lower Rating	GOOD
Upper Rating	ACCEPTABLE
Overall Rating	ACCEPTABLE

Relative Displacement plots:

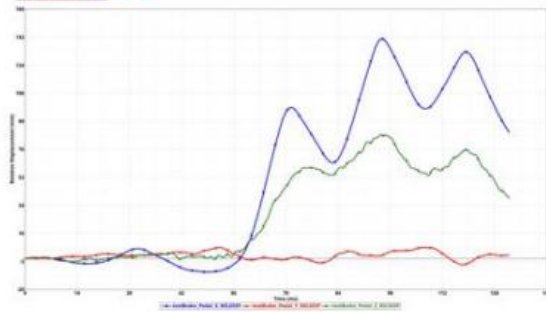
Seat Mount Plots LROSEAT



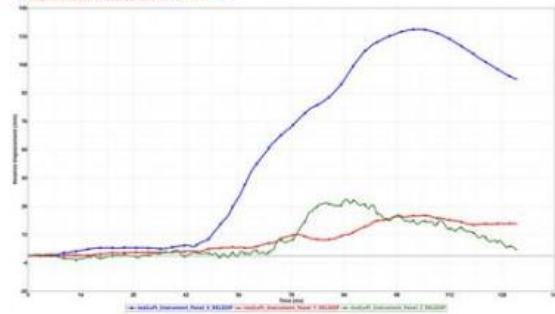
LowerHingePillar Plots



BrakePedal Plots

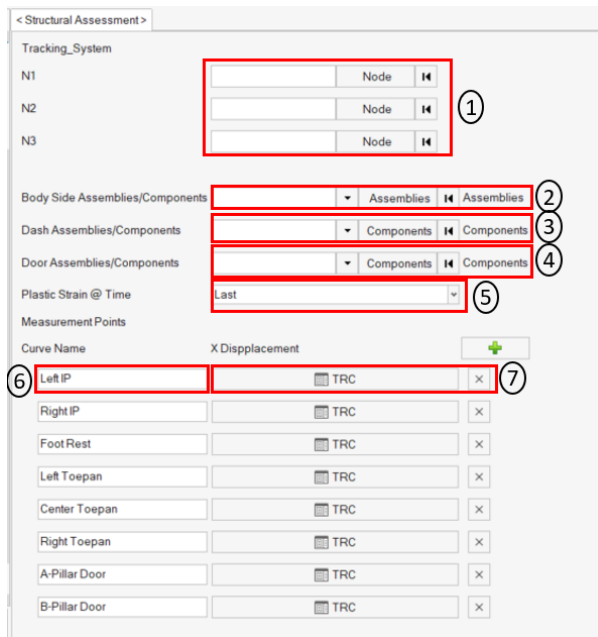


LeftInstrumentPanel Plots



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.

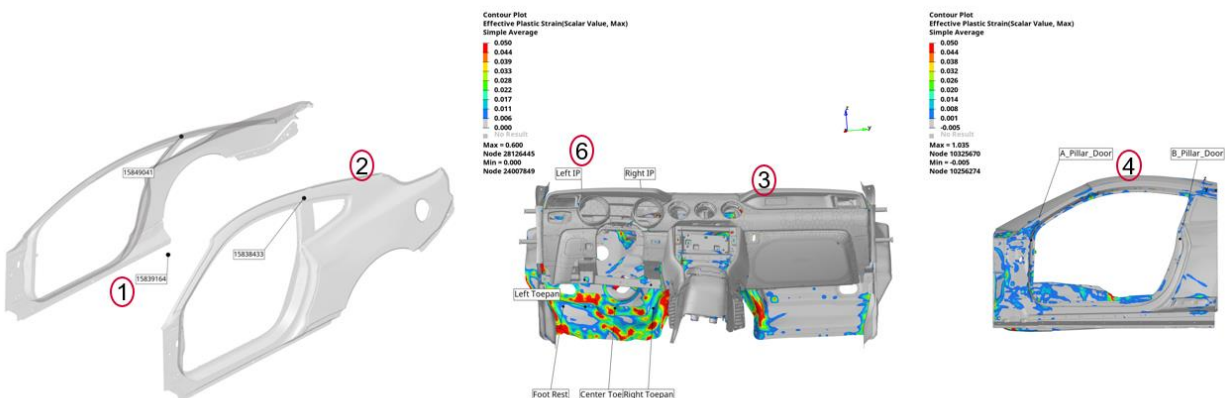


The screenshot shows the 'Structural Assessment' window with the following fields and annotations:

- Tracking_System**: N1, N2, N3. A red box highlights the 'Node' dropdowns for N1, N2, and N3, with a circled '1' next to it.
- Body Side Assemblies/Components**: A dropdown menu with 'Assemblies' selected. A red box highlights this dropdown, with a circled '2' next to it.
- Dash Assemblies/Components**: A dropdown menu with 'Components' selected. A red box highlights this dropdown, with a circled '3' next to it.
- Door Assemblies/Components**: A dropdown menu with 'Components' selected. A red box highlights this dropdown, with a circled '4' next to it.
- Plastic Strain @ Time**: A dropdown menu with 'Last' selected. A red box highlights this dropdown, with a circled '5' next to it.
- Measurement Points**: A table with columns 'Curve Name' and 'X Displacement'. A red box highlights the 'Left IP' row, with a circled '6' next to it. The 'X Displacement' column for 'Left IP' has a dropdown menu with 'TRC' selected, highlighted by a red box and a circled '7'.

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.

< Structural Vehicle Kinematics >

Filter

180

1

Title
Y Velocity
Y Displacement
X Displacement

+

2

LHS Rocke

TRC

TRC

TRC

×

3

LHS Rocke

TRC

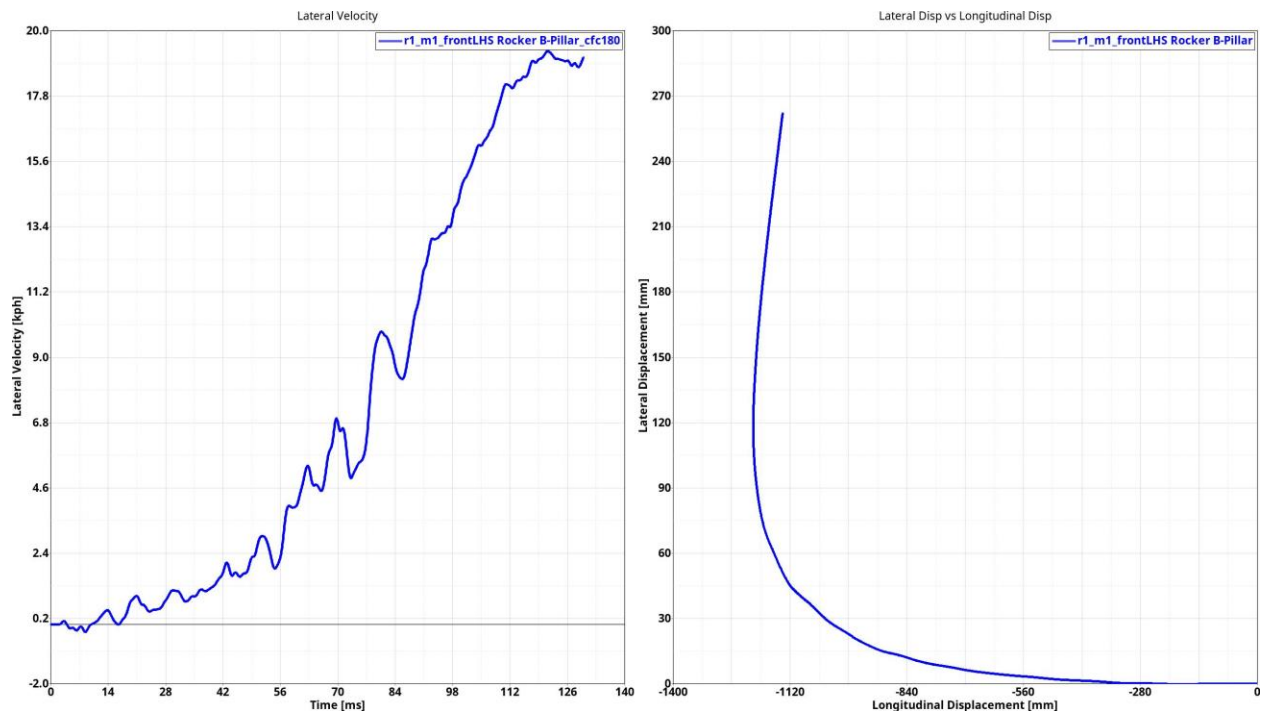
TRC

TRC

×

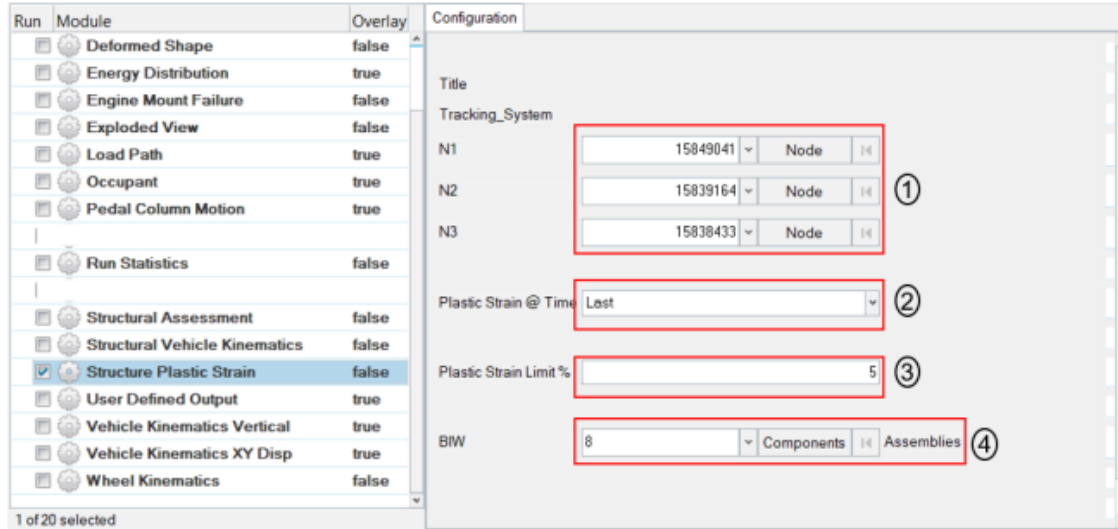
Inputs:

- 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

Structure Observations Front Structure EPS - Left

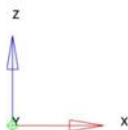
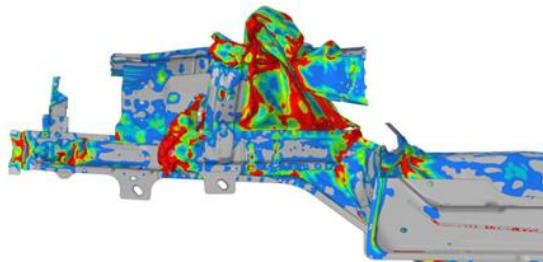
© Altair Engineering, Inc. Proprietary and Confidential. All rights reserved.

Contour Plot
Effective plastic strain(Scalar value, Max)
Simple Average

5.000E-02
4.393E-02
3.787E-02
3.180E-02
2.573E-02
1.967E-02
1.360E-02
7.533E-03
1.467E-03
-4.600E-03

No Result

Max = 1.803E+00
Node 10049911



User Defined Output

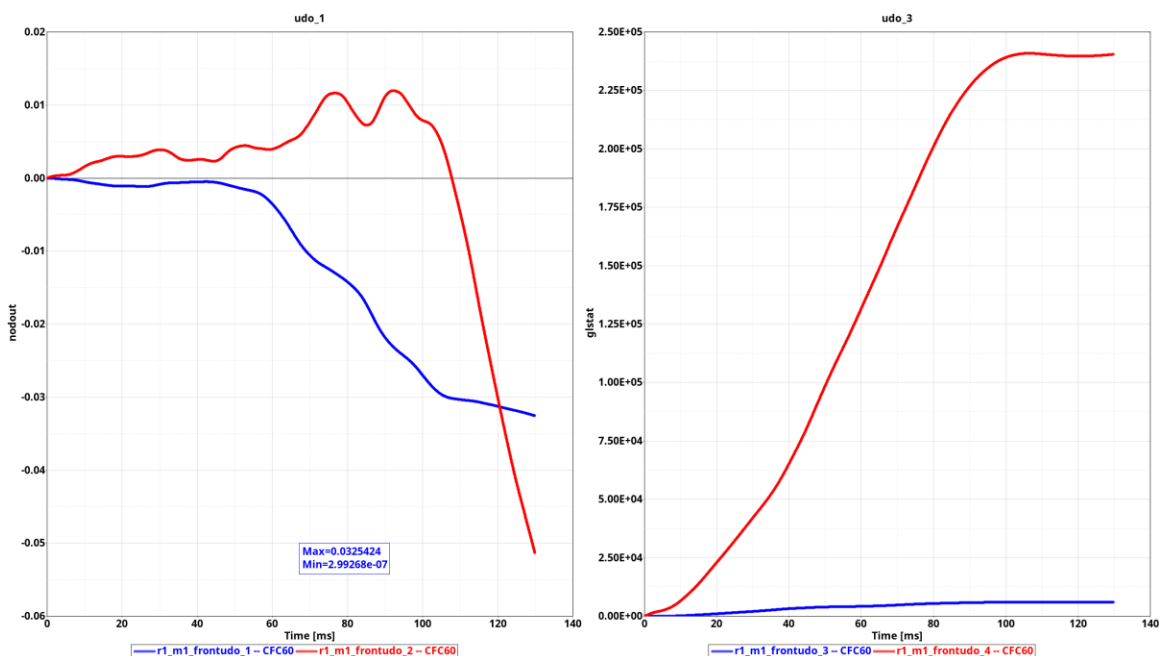
As the name suggests this module allows users to plot program specific Time History data. The plots are created based on user defined list of inputs as shown in the UI below.

Run	Module	Overlay	Configuration							
#Title	Subcase	Y Type	Y Request	Y Component	Filter	Note	X Axis Scale	Y Axis Scale	Window	
udo_1	nodout	nodout	Local1_Rx_rn_tpr 100	ry_displacement	CFC60	Yes	1	1	1	
udo_2	nodout	nodout	Local1_Rx_rn_tpr 100	rx_displacement	CFC60	No	1	1	1	
udo_3	glstat	glstat		hourglass_energy	CFC60	No	1	1	1	
udo_4	glstat	glstat		internal_energy	CFC60	No	1	1	1	
udo_5	matsum	matsum	BR-Stopper_Inve 250	x_momentum	CFC60	Yes	1	1	1	
udo_6	matsum	matsum	JRT-151371A2DBR	x_momentum	CFC60	Yes	1	1	1	
udo_7	rbout	rbout	1895_1	discon_22	CFC60	Yes	1	1	1	
udo_8	rcforc	rcforc	VehicleOCB_3H-G0fs	y_force	CFC60	Yes	1	1	1	
udo_9	rcforc	rcforc	SteeringColumn2Suro	x_moment	CFC60	Yes	1	1	1	
udo_10	sectorc	sectorc	Tunnel1 108950	y_centroid	CFC60	Yes	1	1	1	

Inputs:

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

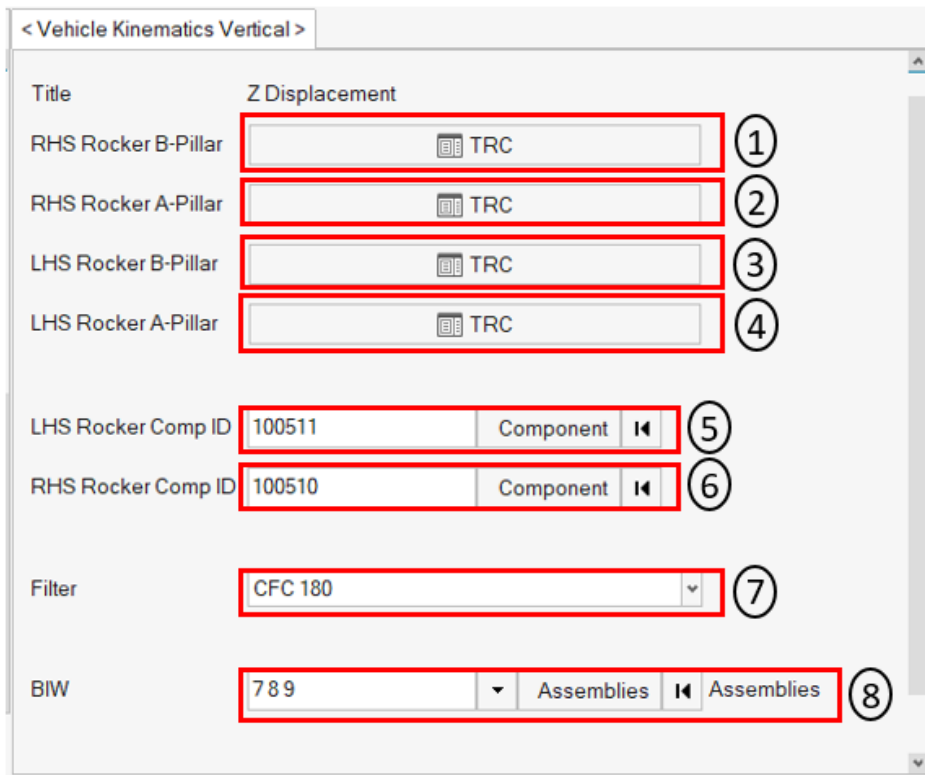
- Label to be used as plot header
- Subcase name, Y Type, Y Request & Y Component from the Time History file
- Filter class to be used
- Note with Min & Max value is required to be created
- X & Y axes scale factors if required to be used
- Window number to be used when plotting the curves
- Y axis unit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

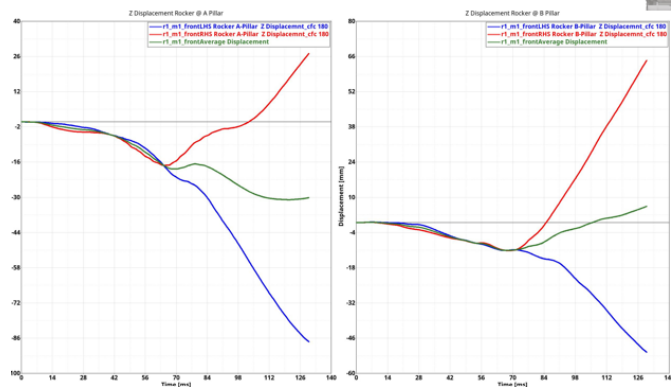
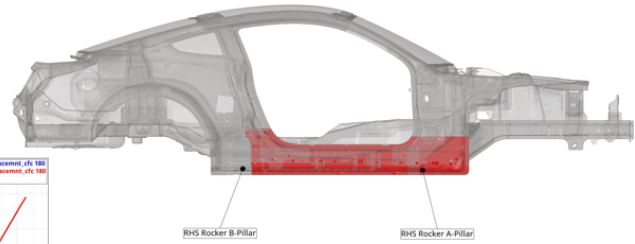


Title	Z Displacement
RHS Rocker B-Pillar	TRC
RHS Rocker A-Pillar	TRC
LHS Rocker B-Pillar	TRC
LHS Rocker A-Pillar	TRC
LHS Rocker Comp ID	100511 Component
RHS Rocker Comp ID	100510 Component
Filter	CFC 180
BIW	789 Assemblies Assemblies

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.

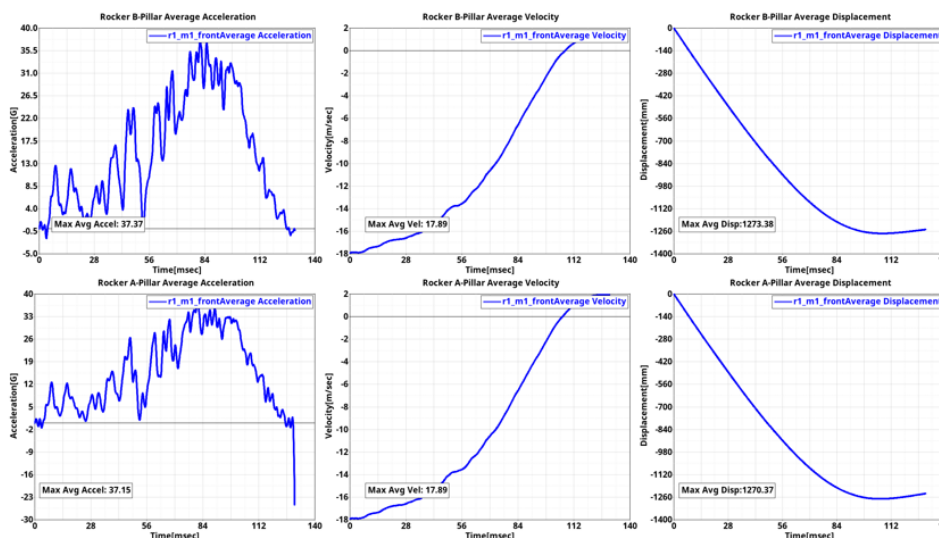
< Vehicle Kinematics XY Disp >						
Title	X Acceleration	X Velocity	X Displacement	Y Acceleration	Y Velocity	Y Displacement
RHS Rocker B-Pillar	TRC	TRC	TRC	TRC	TRC	TRC
RHS Rocker A-Pillar	TRC	TRC	TRC	TRC	TRC	TRC
LHS Rocker B-Pillar	TRC	TRC	TRC	TRC	TRC	TRC
LHS Rocker A-Pillar	TRC	TRC	TRC	TRC	TRC	TRC
Filter						

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

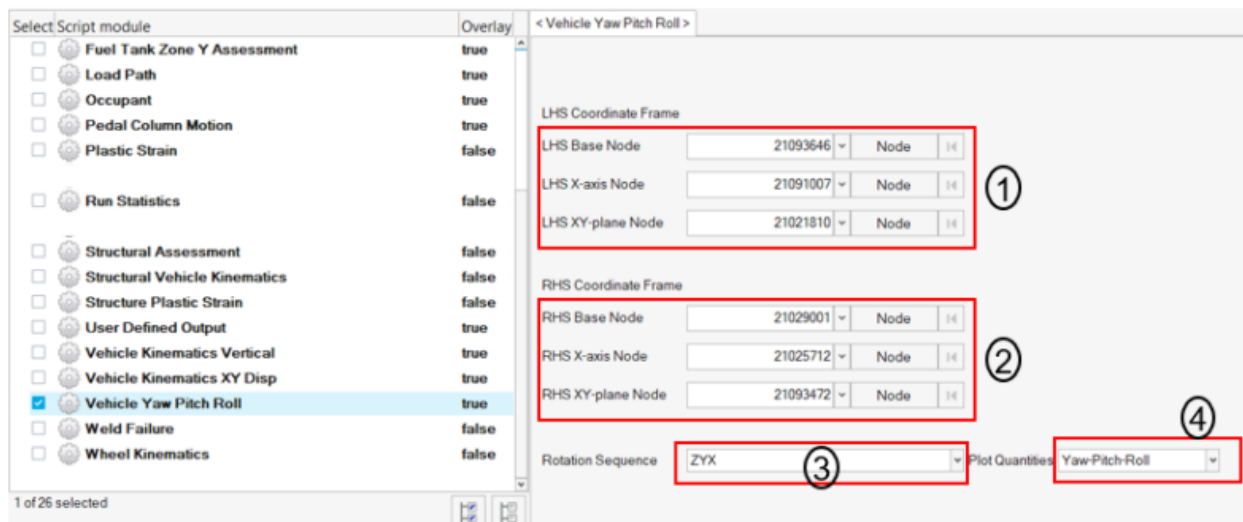


Vehicle Yaw Pitch Roll

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)



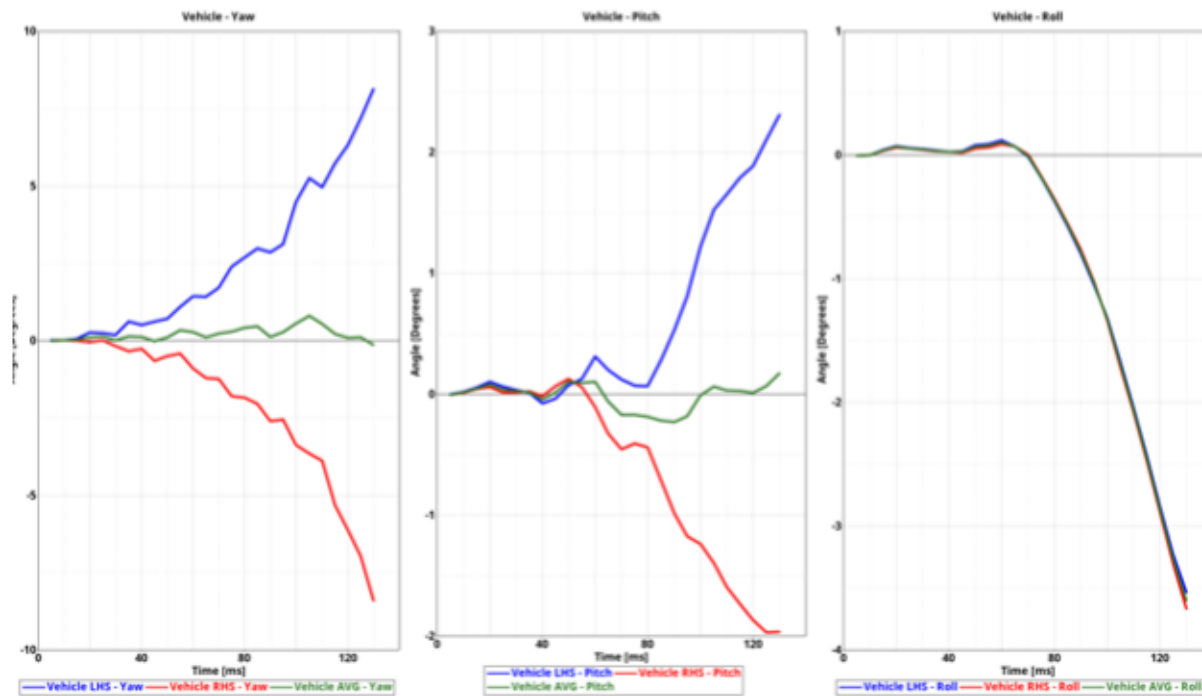
Inputs:

- 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



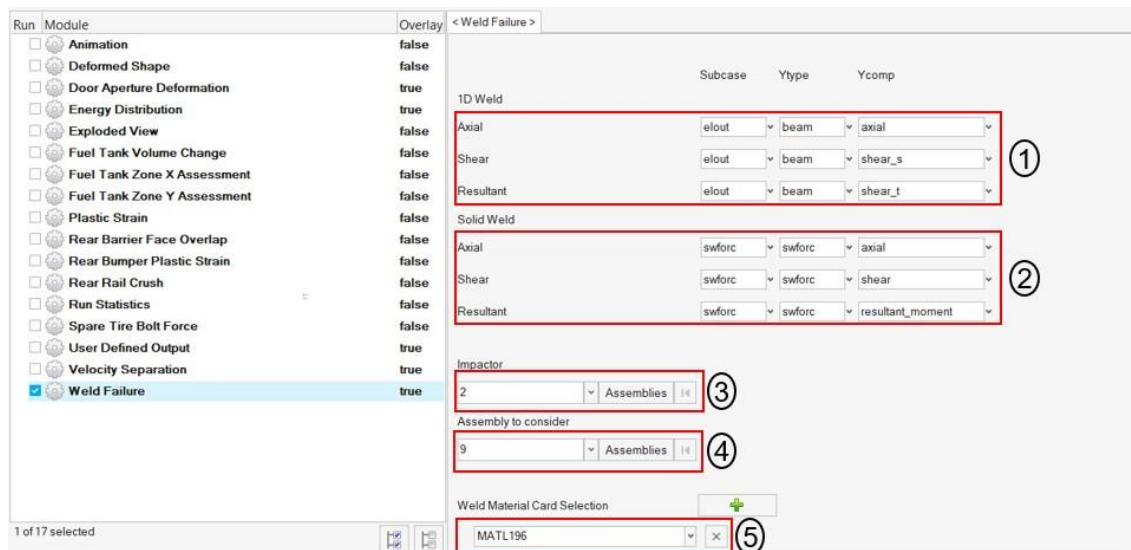
Weld Failure

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

- 1D beam spot welds
- Single hexa spot welds
- Hexa nuggets (cluster of hexa elements)
- 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 with all 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 the weld type found in the model.
- For 1D beam spot weld & single hexa spot weld types, the report contains an isolated view of the weld & its linked components & a graphs showing the axial, shear & resultant plots across the time steps.
- For hexa nuggets & hexa adhesive weld types, the report contains detailed view of the weld containing the linked components.



The screenshot shows the 'Weld Failure' module interface in Altair HyperMesh. The left sidebar lists various modules, with 'Weld Failure' selected. The main panel displays the following configuration options:

- Overlay:** A list of modules with checkboxes for 'true' or 'false'. 'Weld Failure' is checked.
- 1D Weld:** A table with columns 'Subcase', 'Ytype', and 'Ycomp'. It contains three rows for 'Axial', 'Shear', and 'Resultant' under the 'elout' subcase. These rows are highlighted with a red box and labeled with a circled 1.
- Solid Weld:** A table with columns 'Subcase', 'Ytype', and 'Ycomp'. It contains three rows for 'Axial', 'Shear', and 'Resultant' under the 'swforc' subcase. These rows are highlighted with a red box and labeled with a circled 2.
- Impactor:** A dropdown menu set to '2' and a button 'Assemblies'. This is highlighted with a red box and labeled with a circled 3.
- Assembly to consider:** A dropdown menu set to '9' and a button 'Assemblies'. This is highlighted with a red box and labeled with a circled 4.
- Weld Material Card Selection:** A dropdown menu set to 'MATL196' and a button 'x'. This is highlighted with a red box and labeled with a circled 5.

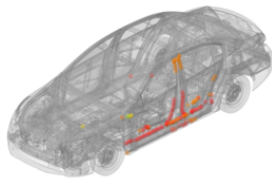
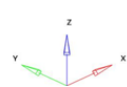
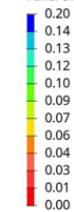
Inputs:

- 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 report generation
- 5) Weld material ID used to find the ruptured welds

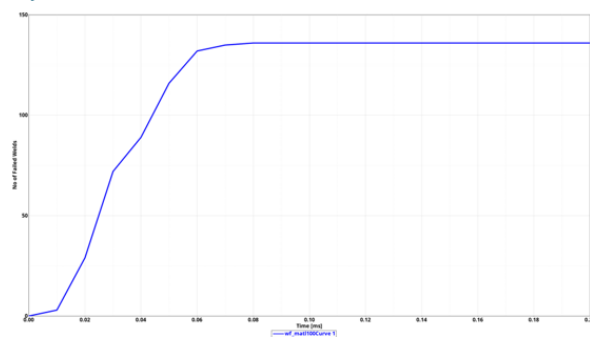
Global viewpoint:

Spot Weld Failure

Contour Plot
FailureTime(Value)



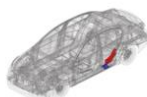
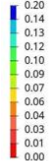
Spot Weld Failure Plot



1D beam spot weld / Single hexa spot weld report

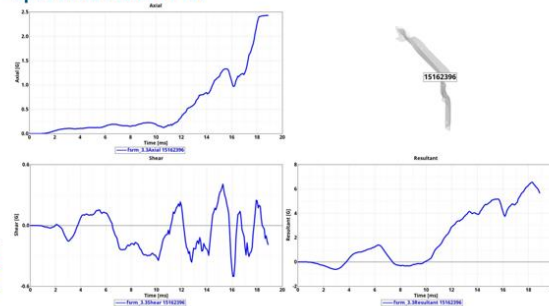
Spot Weld Failure Detail View

Contour Plot
FailureTime(Value)



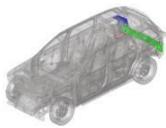
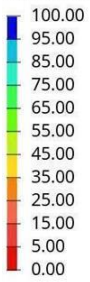
45		
48582		

Spot Weld Failure Plot



Hexa nuggets report:

Contour Plot
FailureTime(Value)

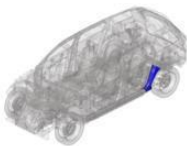
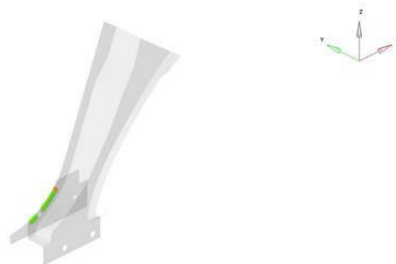
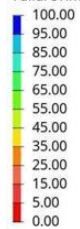


R2FB-S11146-A EXT FLR PAN SD RR 0.8mm	
R2HB-S27944-A 10 REINF RR LP OPG LWR 0.8mm	
R2HB-S40492-A 22 PNL LWR BK I S 0.7mm	

Hexa adhesives report:

Hexa Adhesive Failure Detail View

Contour Plot
FailureTime(Value)



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.

< Wheel Kinematics >

Rail	500600 500601 500162	Components	Components	①
Chassis	27	Assemblies	Assemblies	②
Side Sill	100510 150320 150349	Components	Components	③
Tire	545016 545012	Components	Components	④
View	BOTTOM			⑤
Time	40 45 50 55 60 65			⑥

Tracking System

N1	15849041	Node	⑦
N2	15839164	Node	
N3	15838433	Node	

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

40.00ms ⑥

