

# 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.

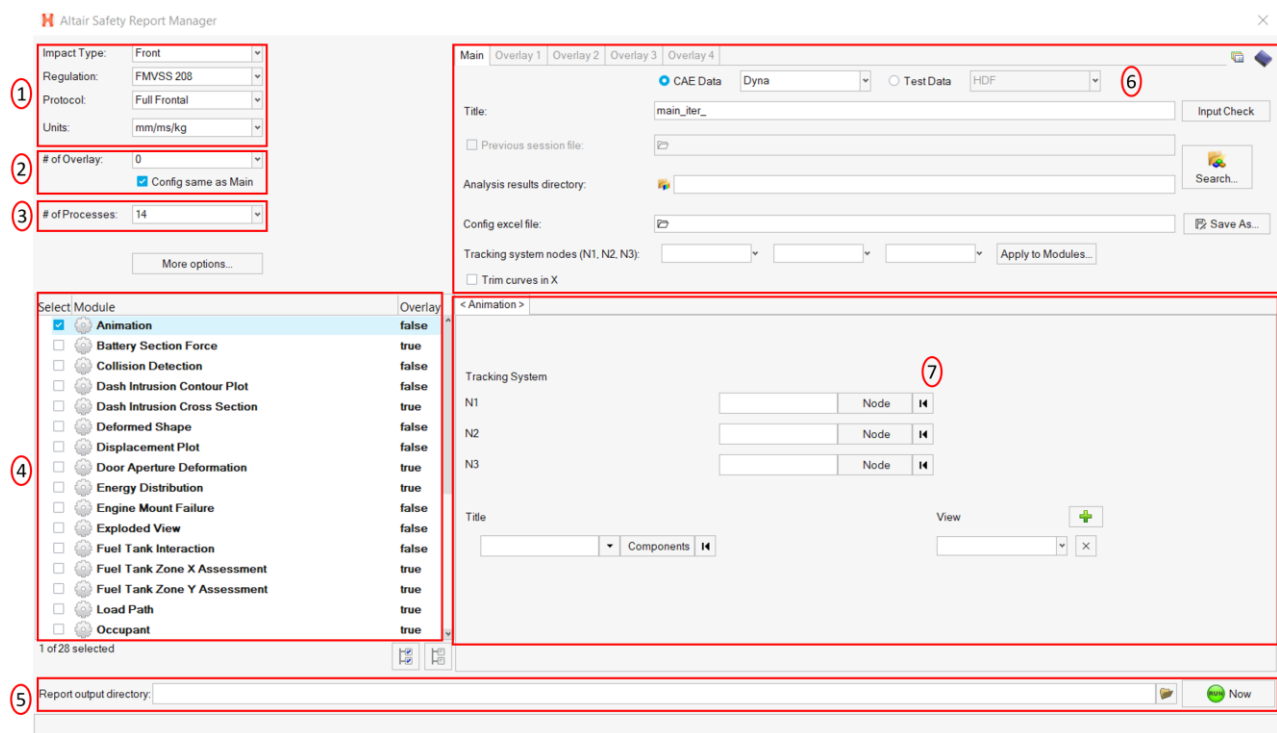
- Model information
- Run quality statistics
- Occupant requirements
- Structure overview
- User defined plots

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.



- 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.

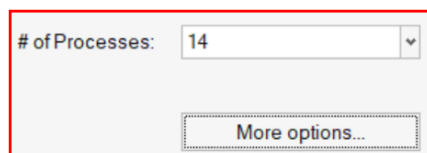


Please note that only those modules which run in HyperGraph (that create curves / graphs) are supported for overlay mode. There is a specific overlay status column next to modules list that indicates the overlay support for each module.

### 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

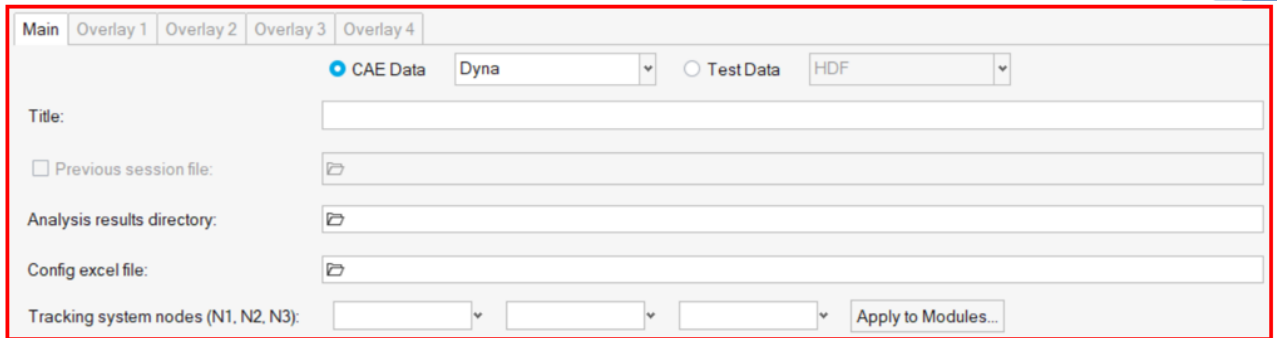
In this section user will select the output directory path. This is where all the output files such as the session files, images, animations, PPT & log files from the ASRM run will be created.

### Main section

#### Input directory & configuration section

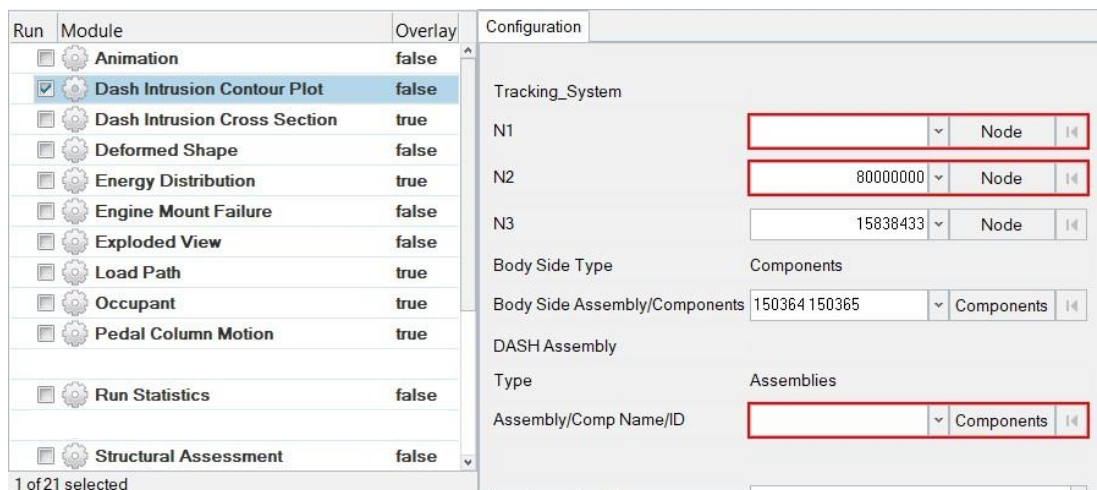
In this section, user will be able to select the following.

- 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 various modules selected 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.



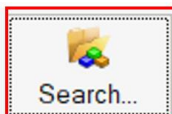
Run	Module	Overlay
<input type="checkbox"/>	Animation	false
<input checked="" type="checkbox"/>	Dash Intrusion Contour Plot	false
<input type="checkbox"/>	Dash Intrusion Cross Section	true
<input type="checkbox"/>	Deformed Shape	false
<input type="checkbox"/>	Energy Distribution	true
<input type="checkbox"/>	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

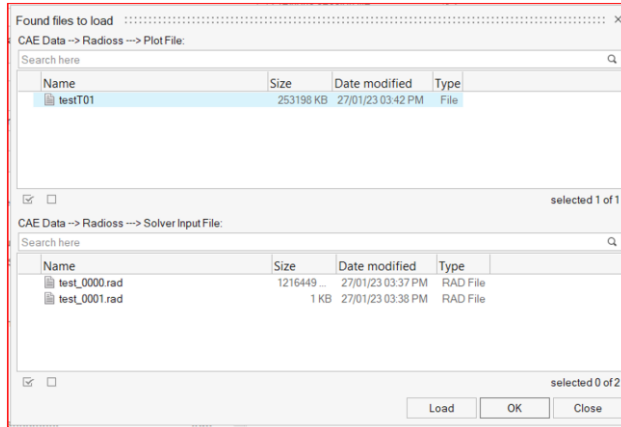
1 of 21 selected

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

## 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 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.

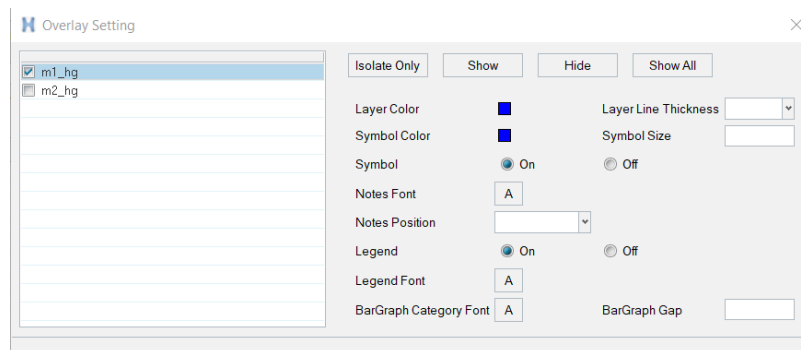





## Change curve attributes & publish session

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 Load 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.



Tracking System

N1	15849041	Node	<
N2	15839164	Node	<
N3	15838433	Node	<

Title

7	Assemblies	<
9	Components	<

View

Top	X
Iso	X

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

HyDriver Restraint Type

Driver ID

Driver Injury Criteria	Subcase	Datatype	Request	Component	Filter
HEAD_ACC_X	tbody				
HEAD_ACC_Y	tbody				
HEAD_ACC_Z	tbody				
HEAD_ACC_RES	tbody				
NECK_UPPER_MOMENT_Y	tbody				
NECK_UPPER_FORCE_X	tbody				
NECK_UPPER_FORCE_Z	tbody				
CHEST_DEFLECTION	tbody				
CHEST_ACC_X	tbody				
CHEST_ACC_Y	tbody				
CHEST_ACC_Z	tbody				

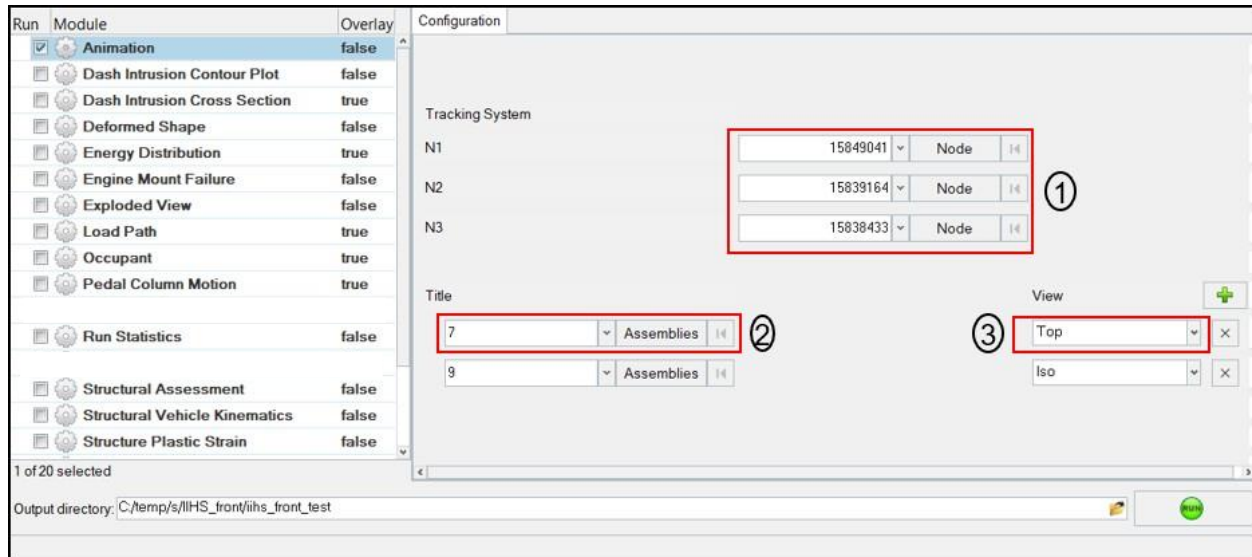
## Modules

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

- Animation
- Animation New
- Battery Section Force
- Collision Detection
- Contour Plot
- Deformed Shape
- Displacement Plot
- Door Aperture Deformation
- Energy Distribution
- Exploded View
- Fuel Tank Interaction
- Fuel Tank Volume Change
- Fuel Tank Zone X Assessment
- Fuel Tank Zone Y Assessment
- Load Path
- Measure Plot
- Plastic Strain
- Rear Barrier Face Overlap
- Rear Bumper Plastic Strain
- Rear Rail Crush
- Run Statistics
- Spare Tire Bolt Force
- User Defined Outputs
- Vehicle Yaw Pitch Roll
- Velocity Separation
- Weld Failure

## Animation

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

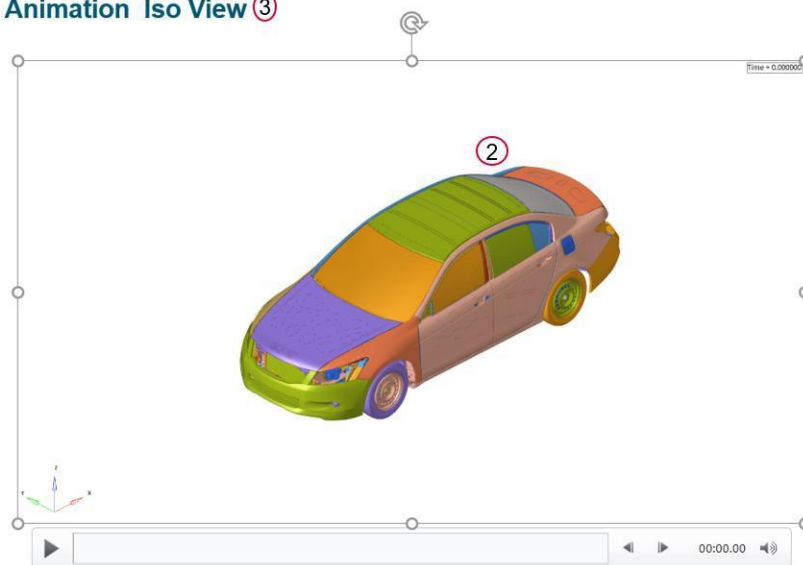


### Inputs:

- 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

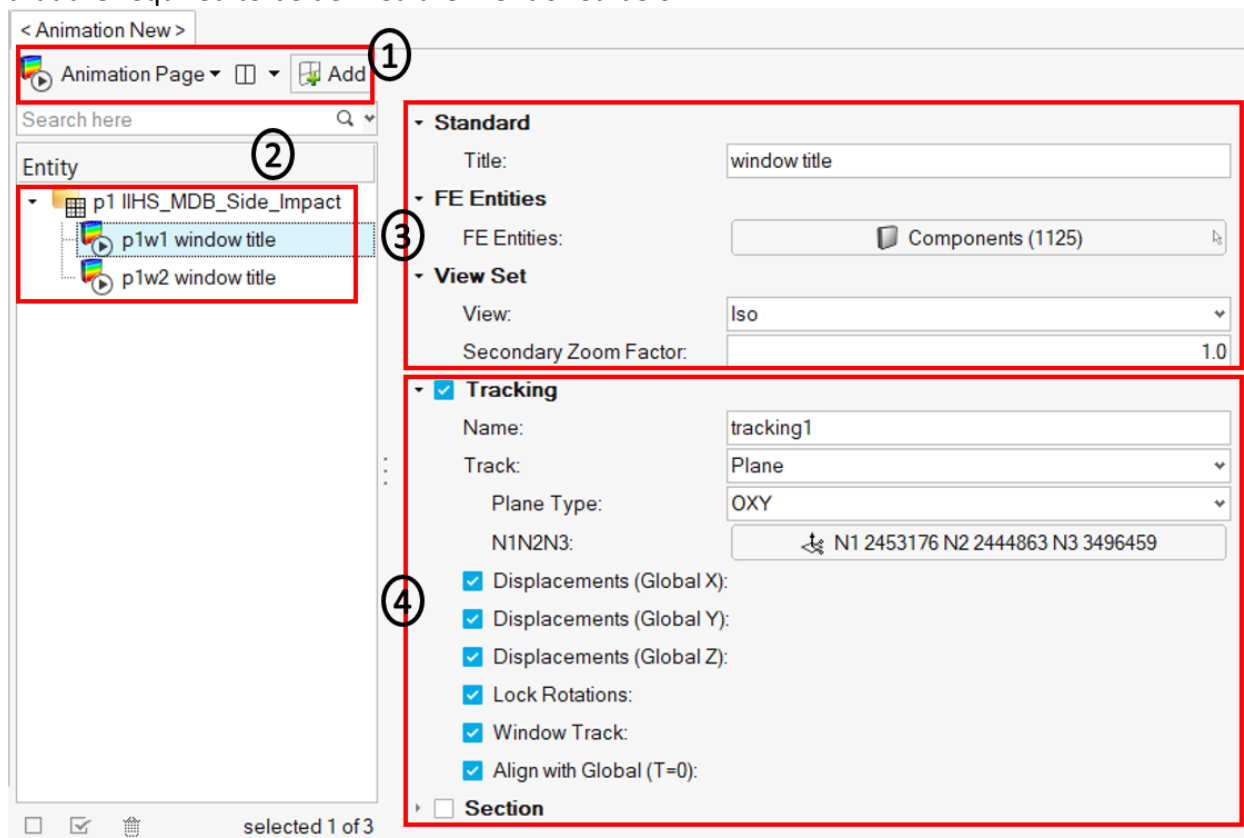
### Output report:

#### Animation Iso View ③



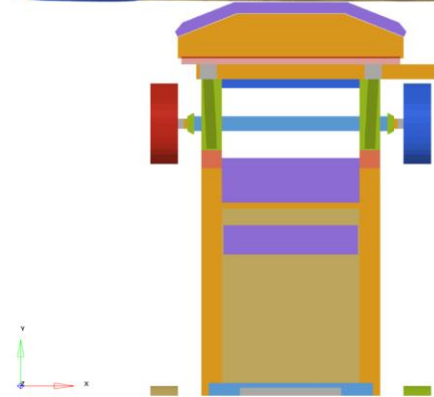
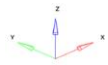
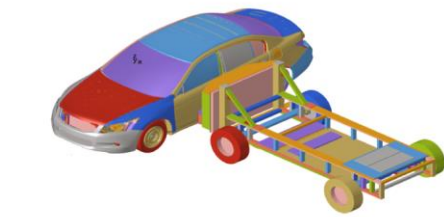
## Animation New

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:

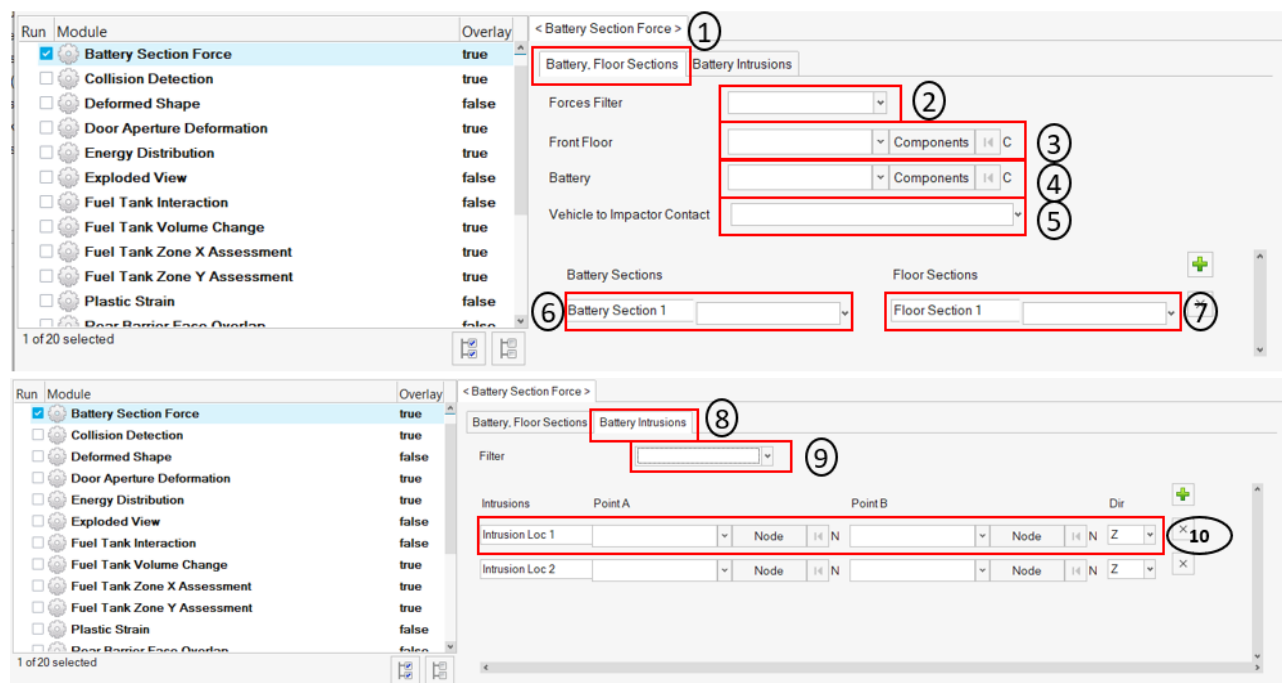
- 1) Use this input to select the page & window layout that will be captured and included in the report. 2 layouts are supported i.e. 1 x 1 and 1 x 2. Select the layout and click on **Add** button to add the page layout into the entity list browser.
- 2) The **Entity** list browser is used to list and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

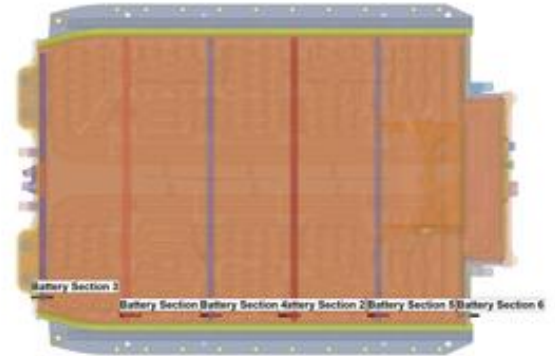
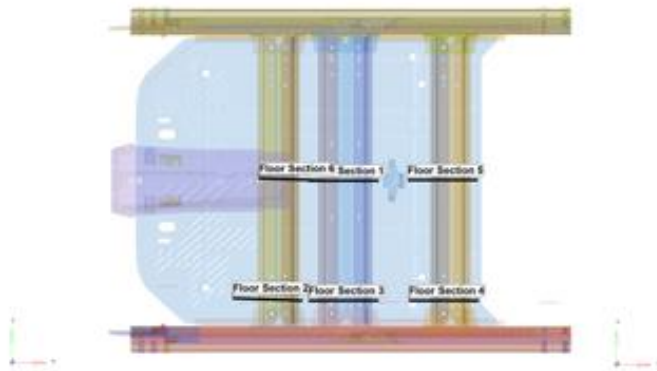
- 1) Images consisting of floor and the battery parts along with cross section members
- 2) A summary table showing the cross-member forces for all the user defined battery & floor sections
- 3) A summary table showing the battery intrusion measurements at various user selected locations
- 4) Images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

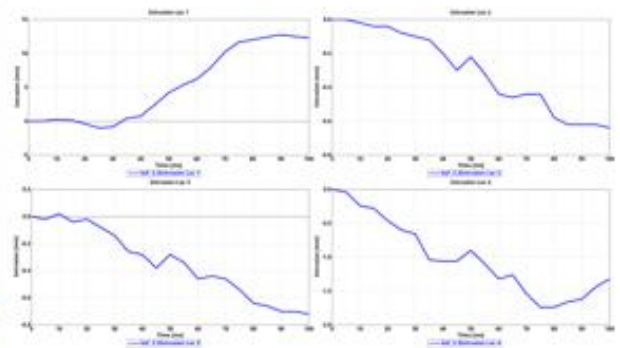
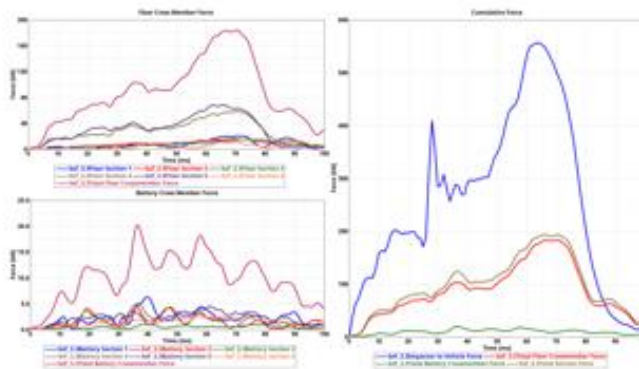
- 1) For battery & floor sections, following inputs are required.
  - a. Filter class to be used for applying the filter to battery & floor cross member section forces plots
  - b. Front floor & battery components or assemblies
  - c. Vehicle to Impactor contact request
  - d. User defined battery &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



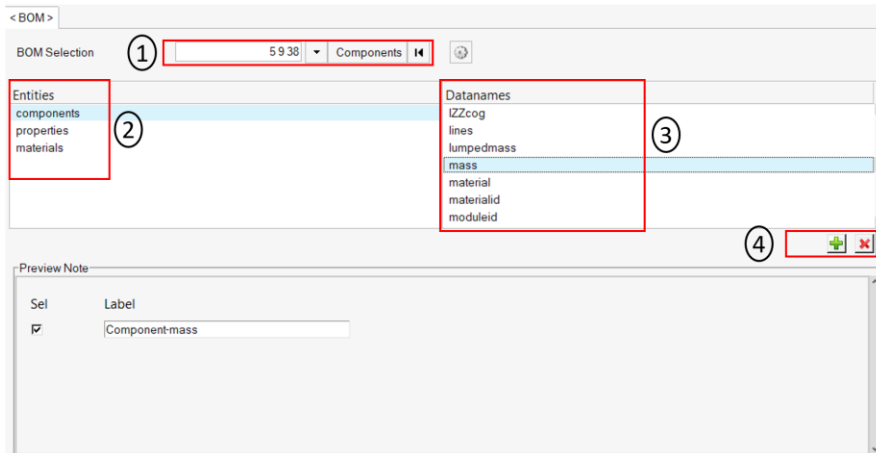
Battery Cross Member Force		Floor Cross Member Force	
Title	Force [kN]	Title	Force [kN]
Battery Section 1	6.37	Floor Section 1	20.89
Battery Section 2	4.44	Floor Section 2	16.18
Battery Section 3	1.07	Floor Section 3	15.36
Battery Section 4	5.10	Floor Section 4	58.88
Battery Section 5	4.56	Floor Section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

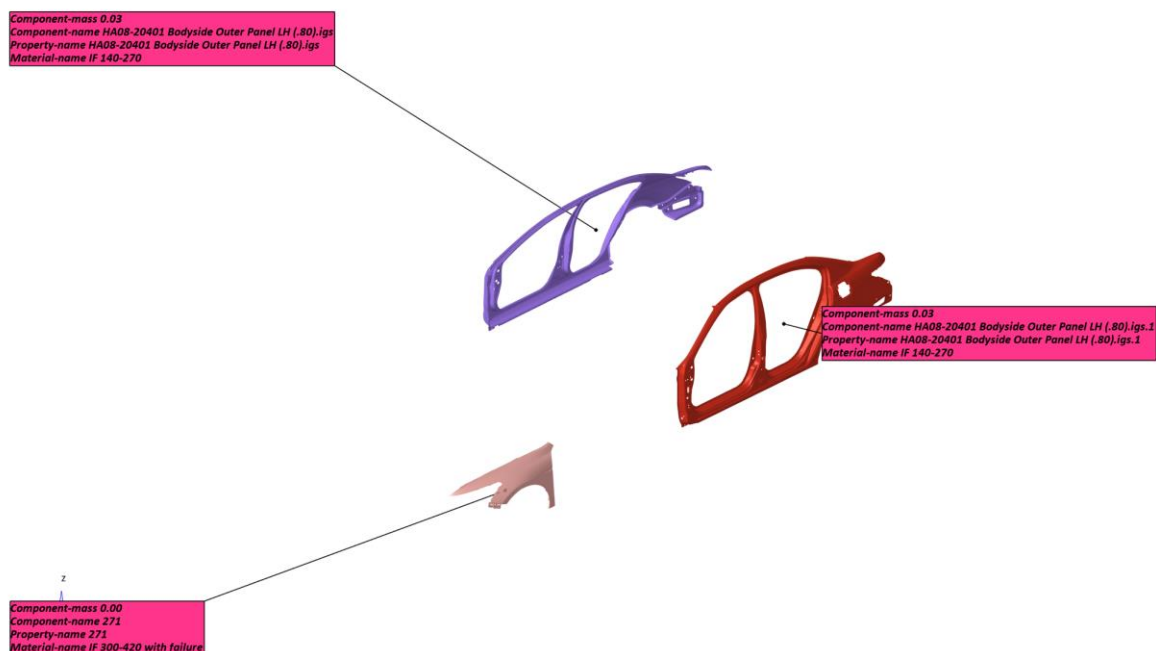
BOM module is an advanced exploded view module. It has the capability to include data name attributes as annotations in the report. Users can pick from several data names (around 100) related to components, property, and material entity attributes. The selected BOM info can be easily attached as annotations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

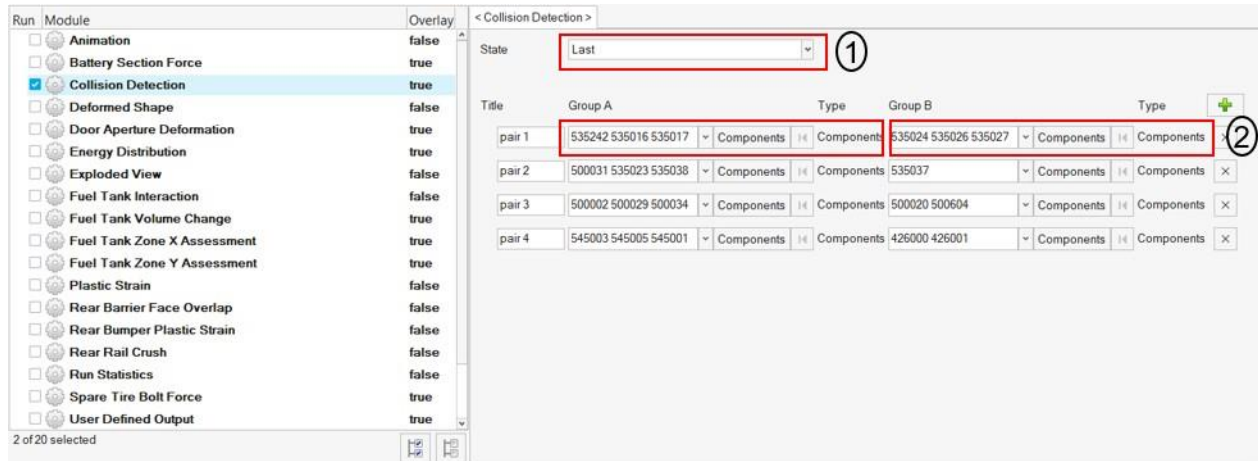
### Output report:





## Collision Detection

Collision detection module is used to perform collision interference checking. This module lets users to define a collision set by selecting a pair or groups of components (parts) and then detect penetration between the two pairs. Users can define multiple collision sets. This capability allows users to quickly perform design reviews.



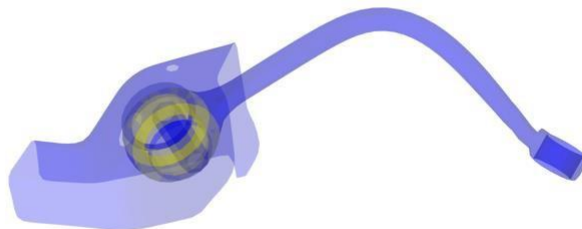
### Inputs:

- 1) Select the time step state at which the collision detection is performed
- 2) Select the components (parts) for each of the two Groups A & B. This forms one collision set. Likewise, users can define multiple collision sets

### Output report:

#### pair 2

Collision Plot  
 Collision  
 Proximity  
 Safe  
 No Result

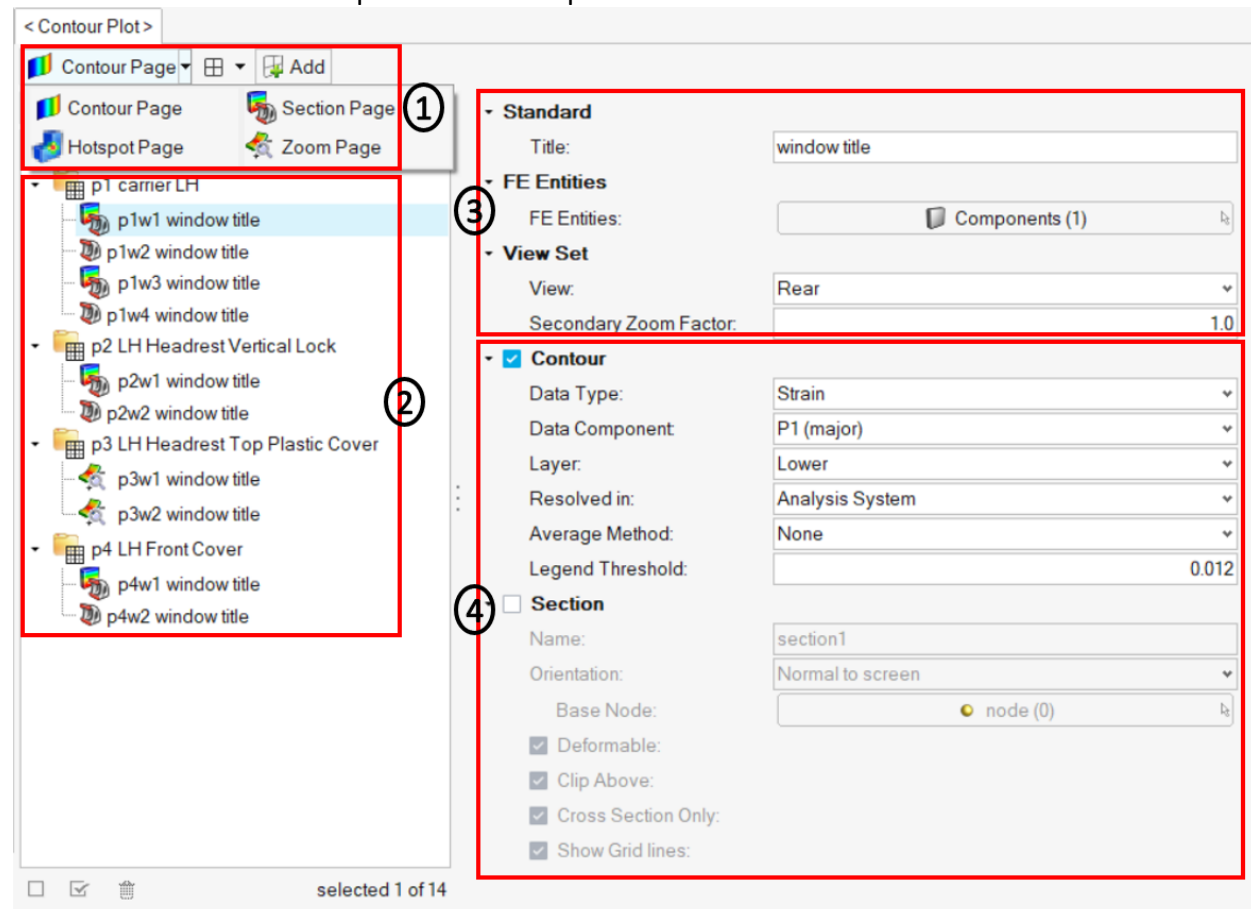


## Contour Plot

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.



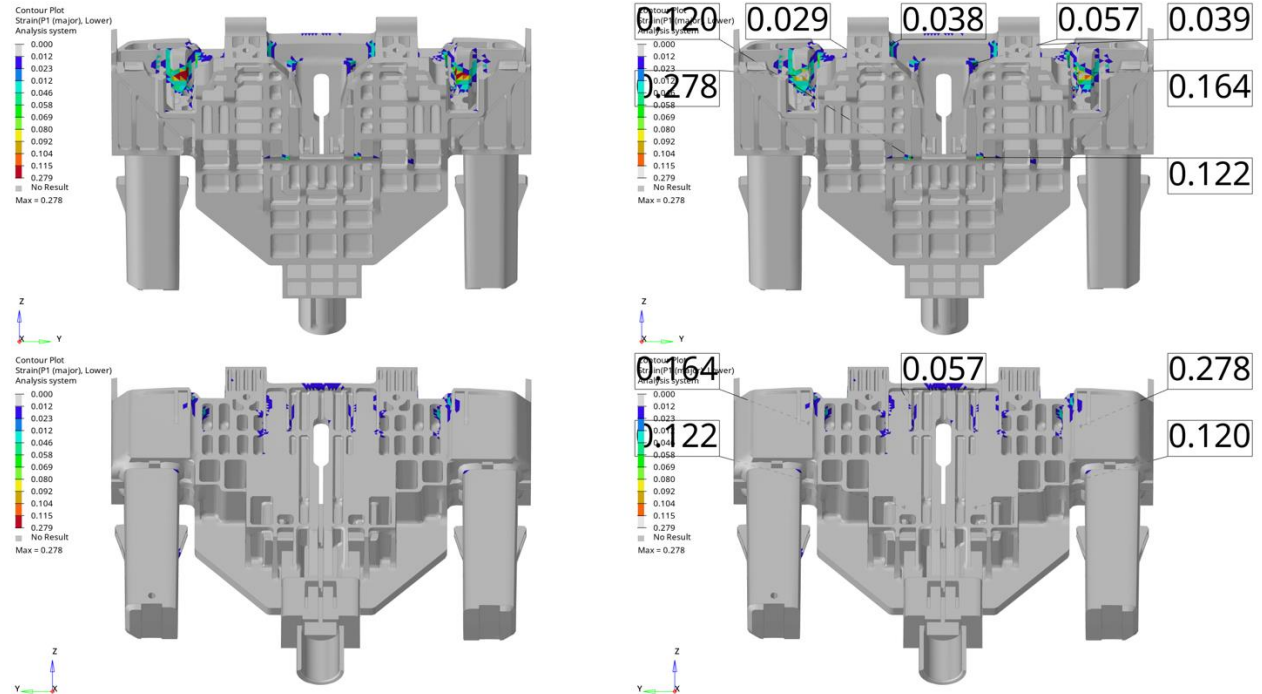
### Inputs:

- 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.

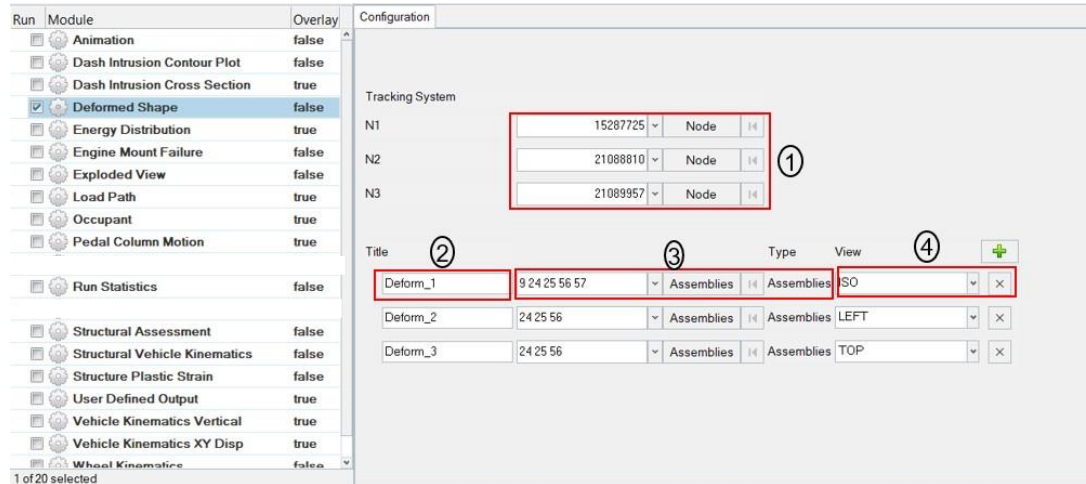
- 2) The **Entity** list browser is used to list and manage the pages included by the user and their respective layouts.
- 3) Enter the **Title** used for the slide title in the report, select the **Components** to be used for the current page type selected and the **View Set** to be used to orient the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



## Deformed Shape

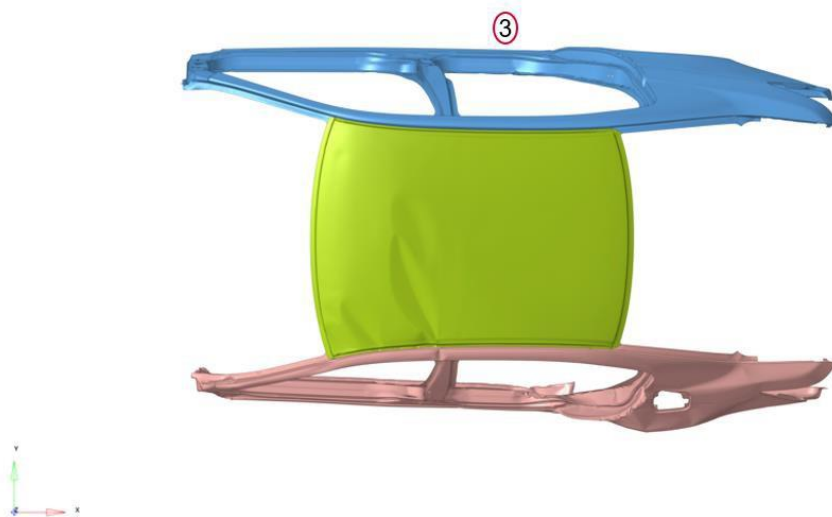
This module is used to create deformed shape of the user selected part sets (components or assemblies) in standard views (Left, Right, Top, Bottom, Front, Rear & Isometric views)



### Inputs:

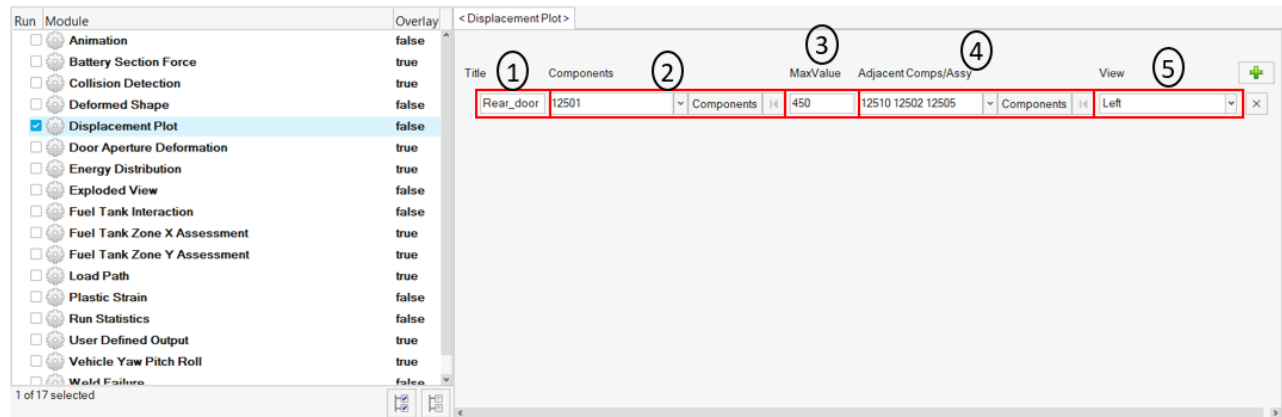
- 1) Node ID 1, 2 & 3 for defining tracking system
- 2) Label to be used for the slide title
- 3) Assembly IDs that will be considered for deformed shape
- 4) The view to be used for deformed shape image capture

### Deformed Shape – Deform\_1\_TOP



## Displacement Plot

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

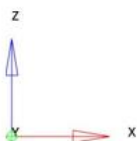
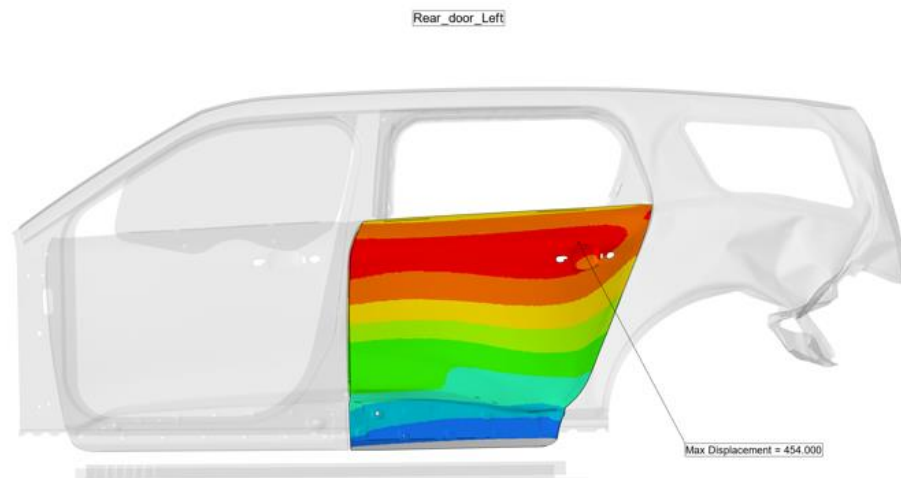


### Inputs:

- 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

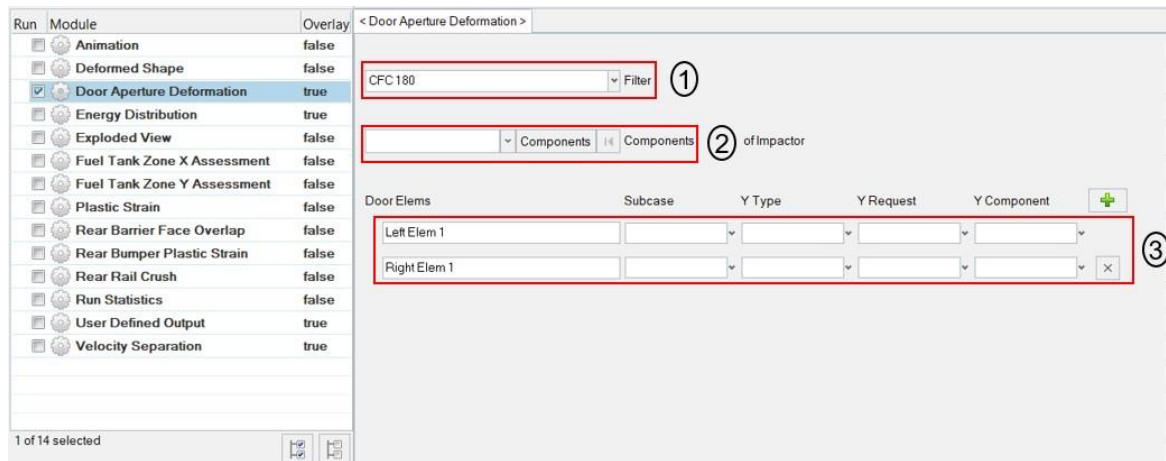
**Contour Plot**  
**Displacement(Mag, Mid)**  
**Analysis system**  
**Simple Average**

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

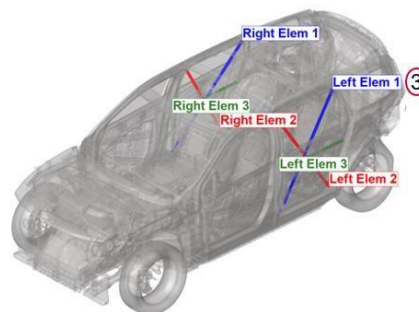
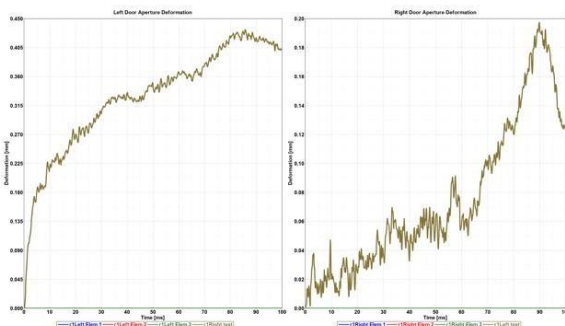
This module is used to record the maximum door deformation using spring elements.



### 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

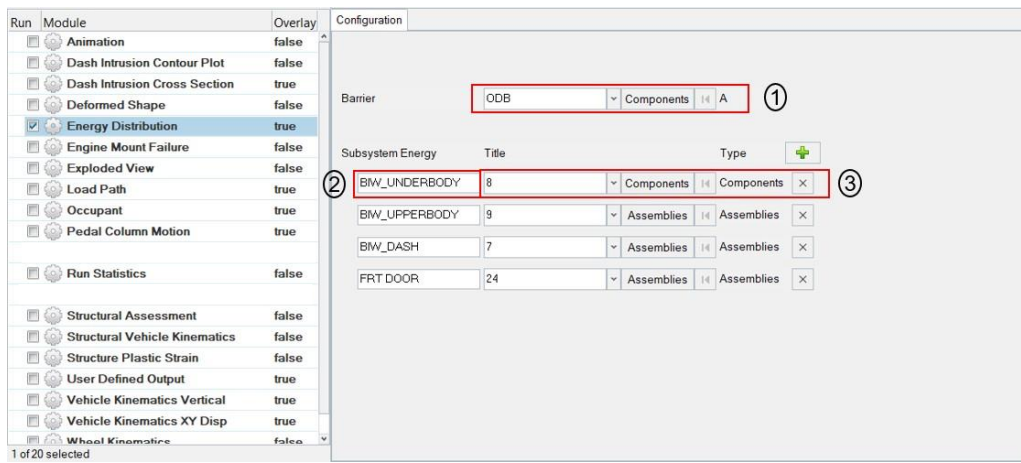


## Energy Distribution

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.

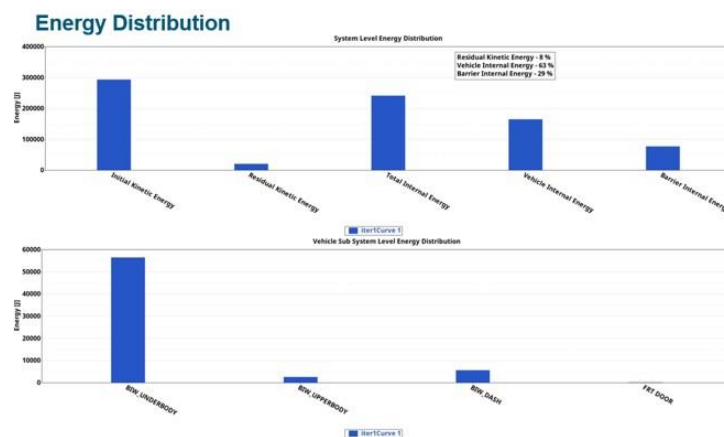
For the barrier, energy plots are created for Initial kinetic energy, residual kinetic energy, total internal energy, vehicle internal energy and barrier internal energy.

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

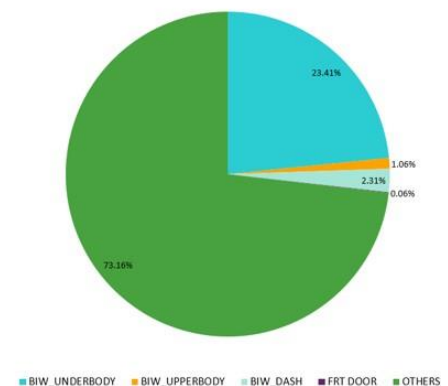


### Inputs:

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



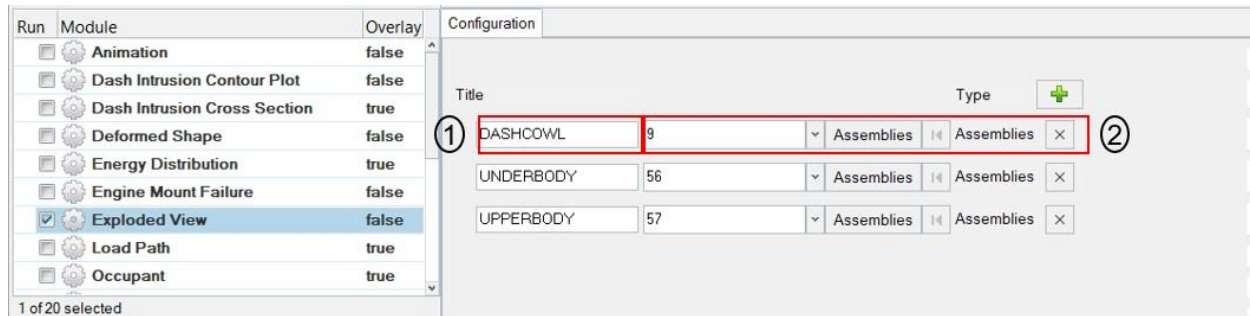
Energy Distribution Pie Chart





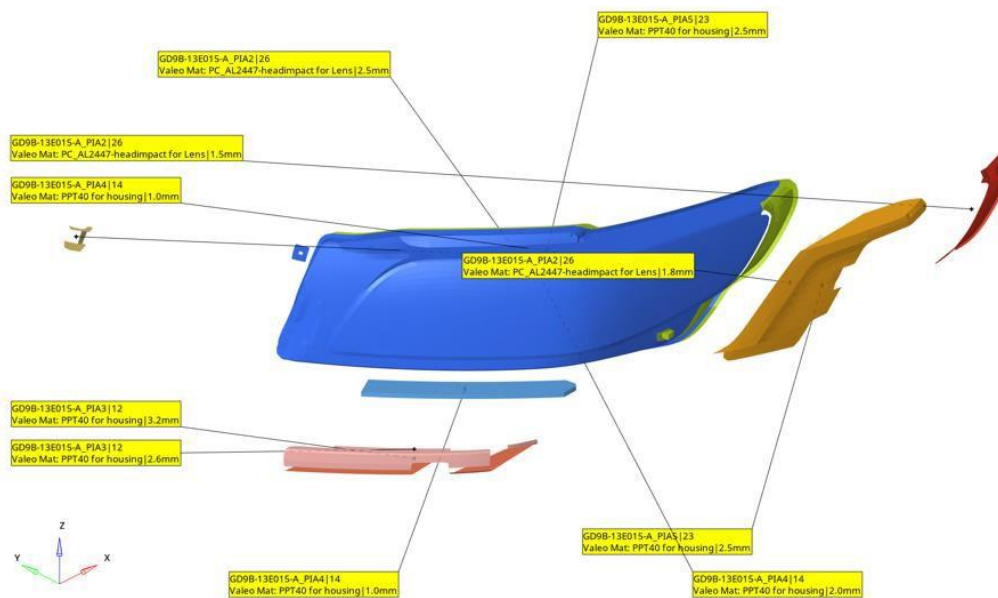
## Exploded View

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:

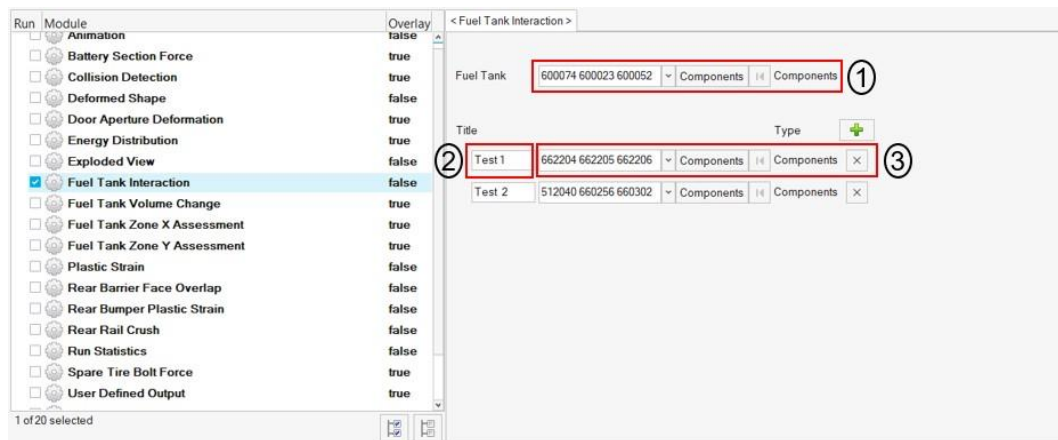
- 1) Title for the assembly that is considered for exploded view
- 2) Assembly or Component ID used for exploded view





## 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.



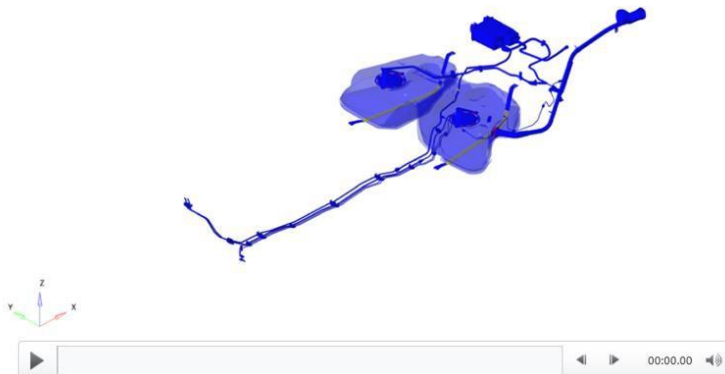
### Inputs:

- 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:

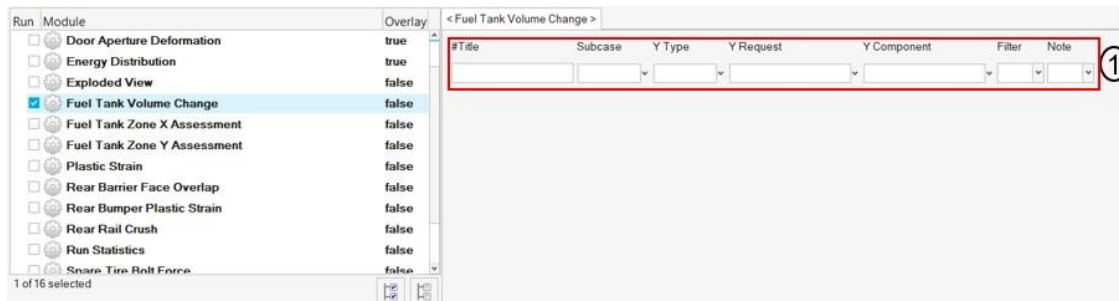
#### Test 1

Collision Plot  
 Collision  
 Proximity  
 Safe  
 No Result



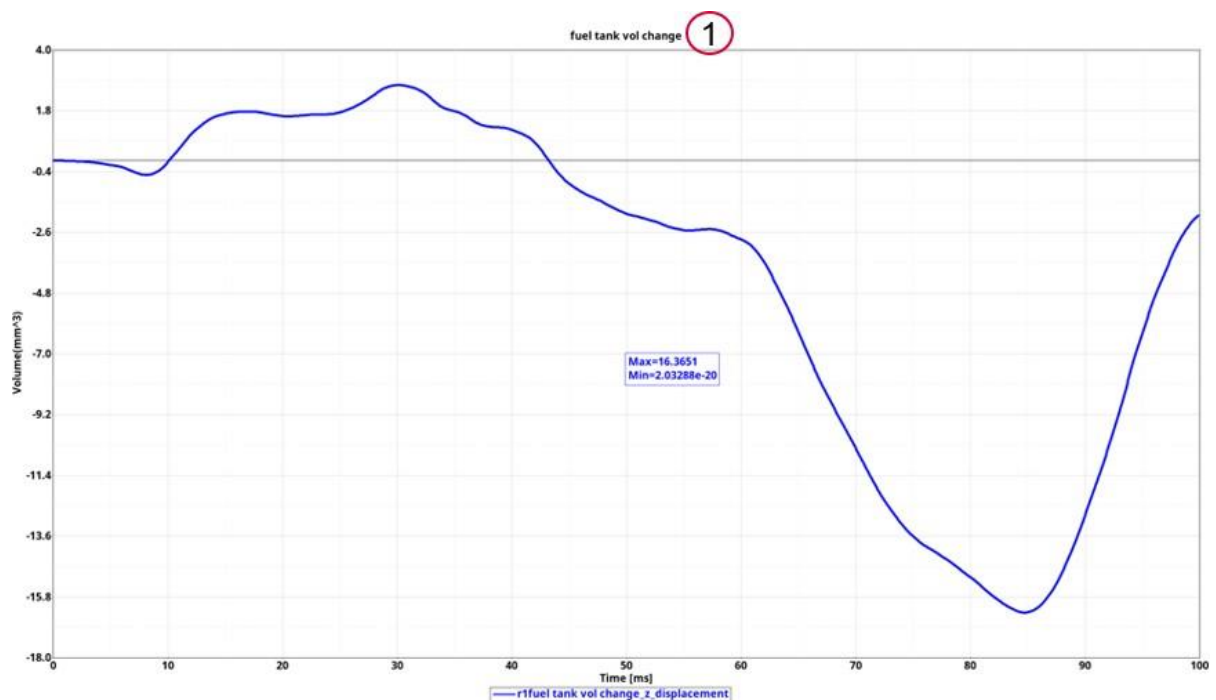
## Fuel Tank Volume Change

This module is used to calculate the maximum percentage volume change for fuel tank across the simulation time steps. A graph of fuel tank volume over time will be plotted.



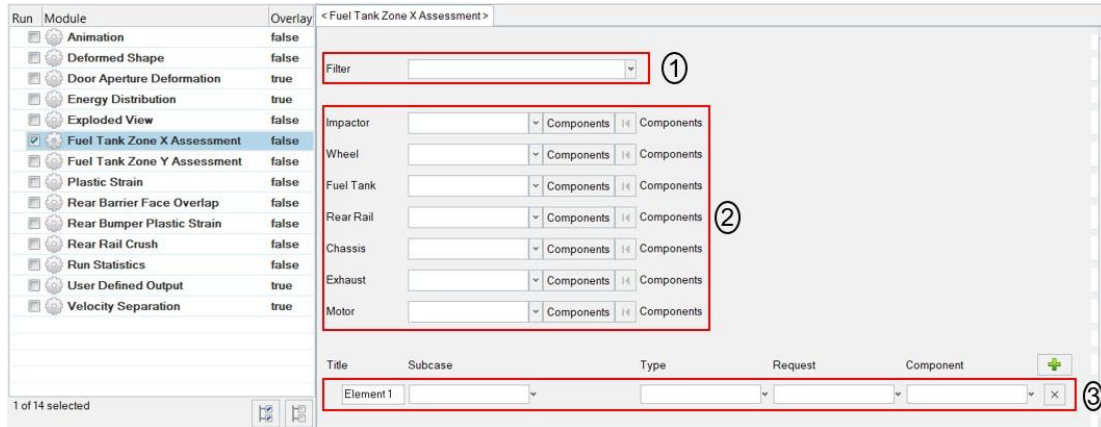
Inputs:

- 1) Enter the title for the plot
- 2) Select the subcase, Y type, Y request & Y component of fuel tank node ID from time history file
- 3) Select filter & note options if required



## Fuel Tank Zone X Assessment

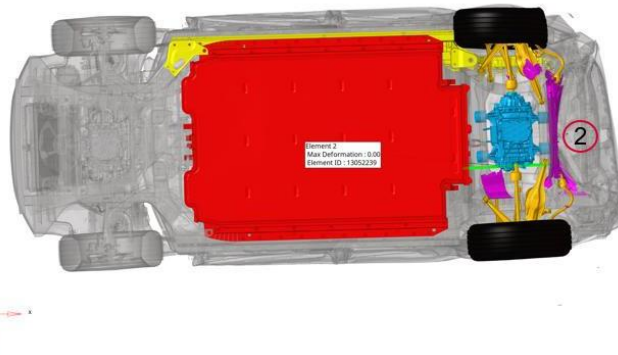
This module is used to evaluate the deformation of fuel tank zone spring elements. It computes the deformation between fuel tank zone cross members along X direction by measuring the spring element deformations.



Inputs:

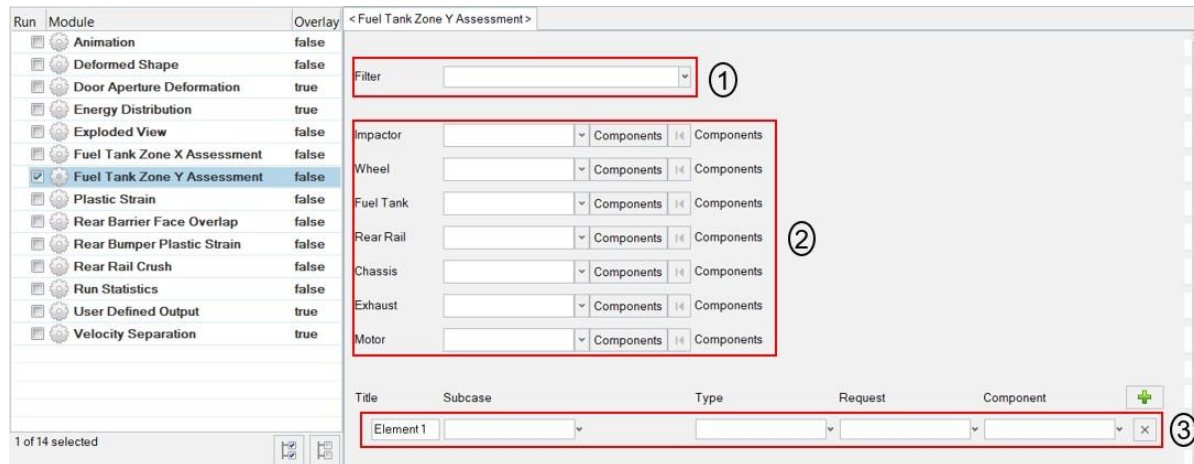
- 1) Filter class to be used if required to filter the deformation curve
- 2) Fuel tank zone cross members comp ID / Assy ID
- 3) The spring element request info (from time history file) for plotting the deformation curves

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



## Fuel Tank Zone Y Assessment

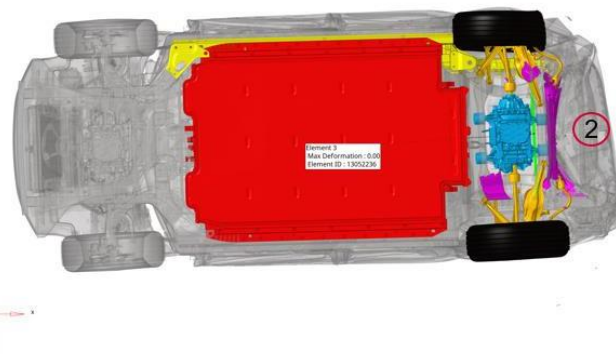
This module is used to evaluate the deformation of fuel tank zone spring elements. It computes the deformation between fuel tank zone cross members along Y direction by measuring the spring element deformations.



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

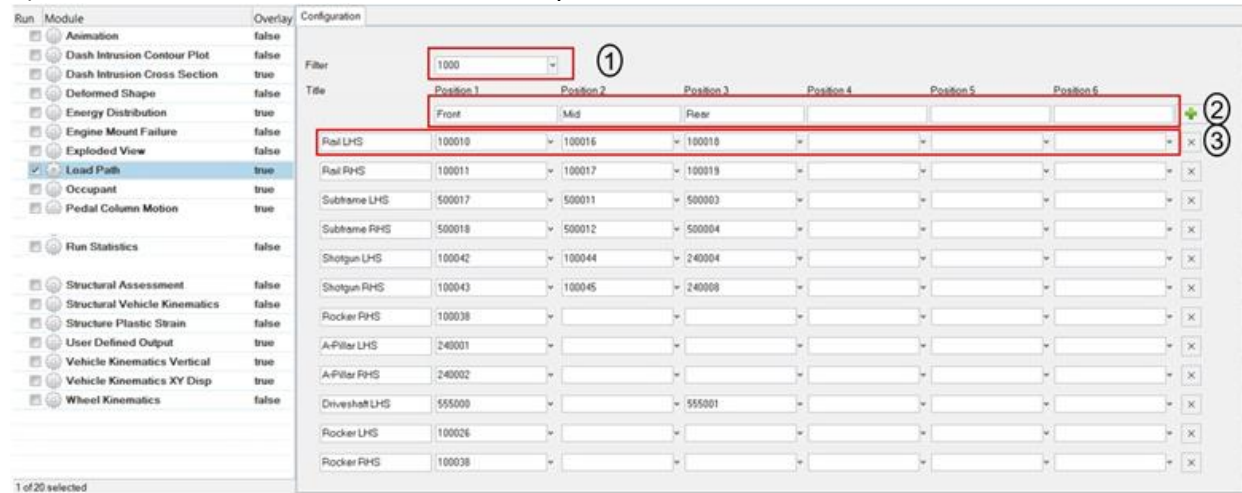
Fuel Tank Zone Y Assessment	
Title	Peak Deformation
Element 1	0.00
Element 2	0.00
Element 3	0.00



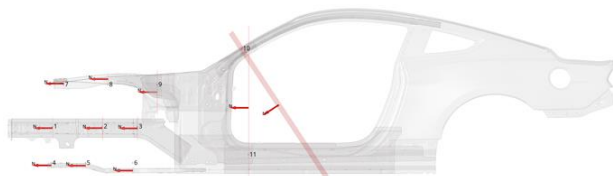
## Load Path

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

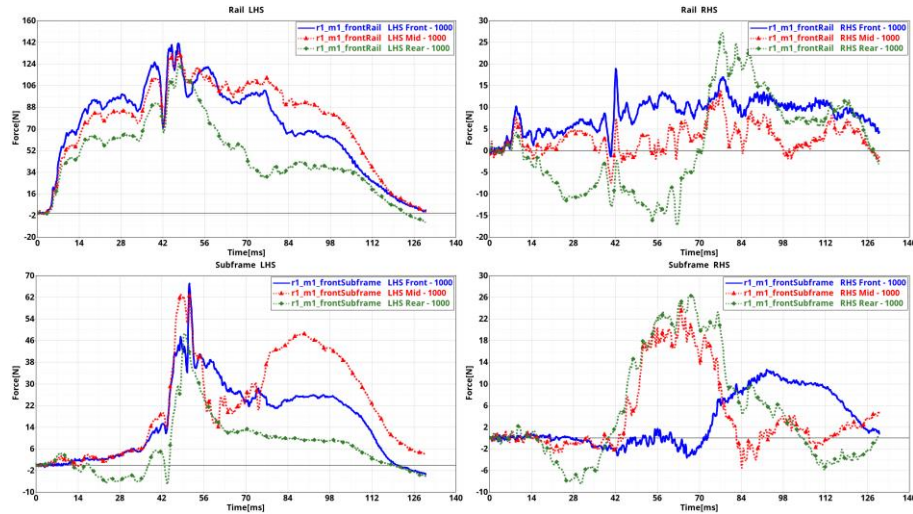


1	Rail Front
2	Rail Mid
3	Rail Rear
4	Subframe Front
5	Subframe Mid
6	Subframe Rear
7	Shotgun Front
8	Shotgun Mid
9	Shotgun Rear
10	A-Pillar Front
11	Rocker Front

## Load Path Summary

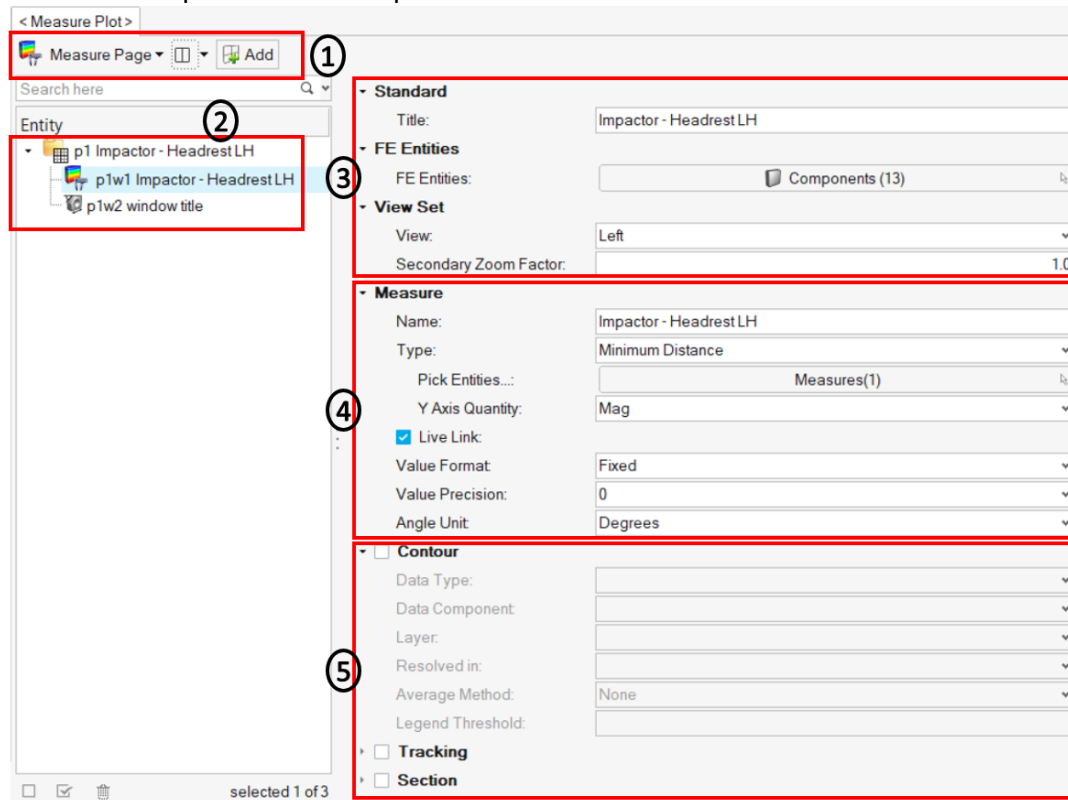
#	Title	Peak Load [kN]	Area (mm <sup>2</sup> )	Ix (mm <sup>4</sup> )	Iy (mm <sup>4</sup> )	J (mm <sup>4</sup> )	Sx (mm <sup>3</sup> )	Sy (mm <sup>3</sup> )	Peak Load [kN]	Area (mm <sup>2</sup> )	Ix (mm <sup>4</sup> )	Iy (mm <sup>4</sup> )	J (mm <sup>4</sup> )	Sx (mm <sup>3</sup> )	Sy (mm <sup>3</sup> )
r1_m1_front															
1	Rail Front	141.00	38.37	178846.17	51224.93	-43216.83	847.13	693.77	18.93	38.37	16516.837	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	18420.611	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	21570.9805	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	97954.5107	904324.39	999808.24	12426.70	3454.34

## Cross Section Force Plot



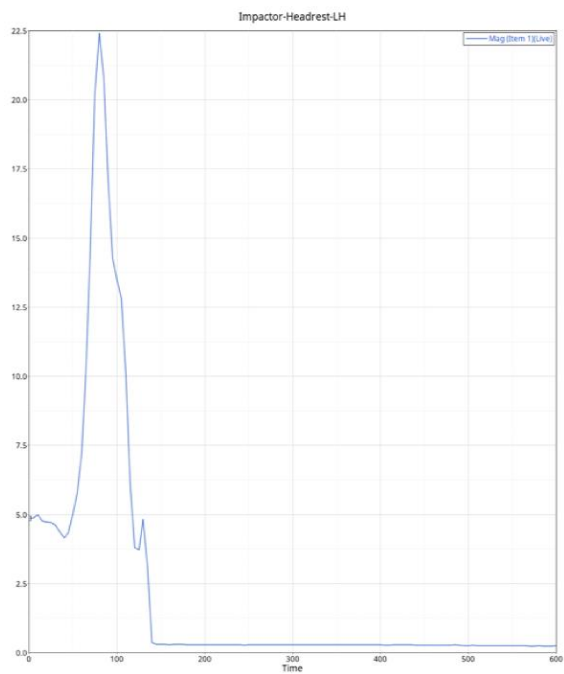
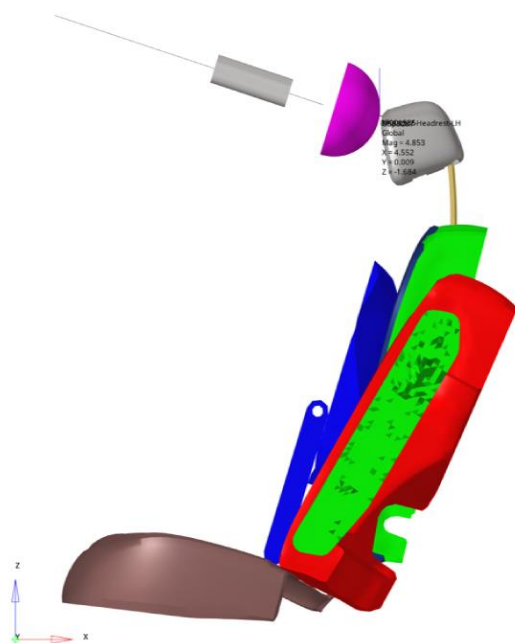
## Measure Plot

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.





## 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.

Run Module

</

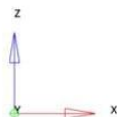
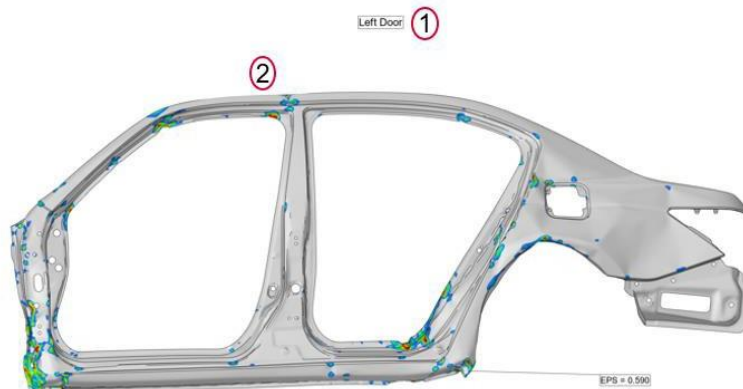
### Inputs:

- The component label
- The plastic strain component IDs to be plotted
- The plastic strain limit that is set when applying the contour
- The adjacent (or neighboring) components to be included in the image (transparent mode)
- The standard view that should be used when capturing the image

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

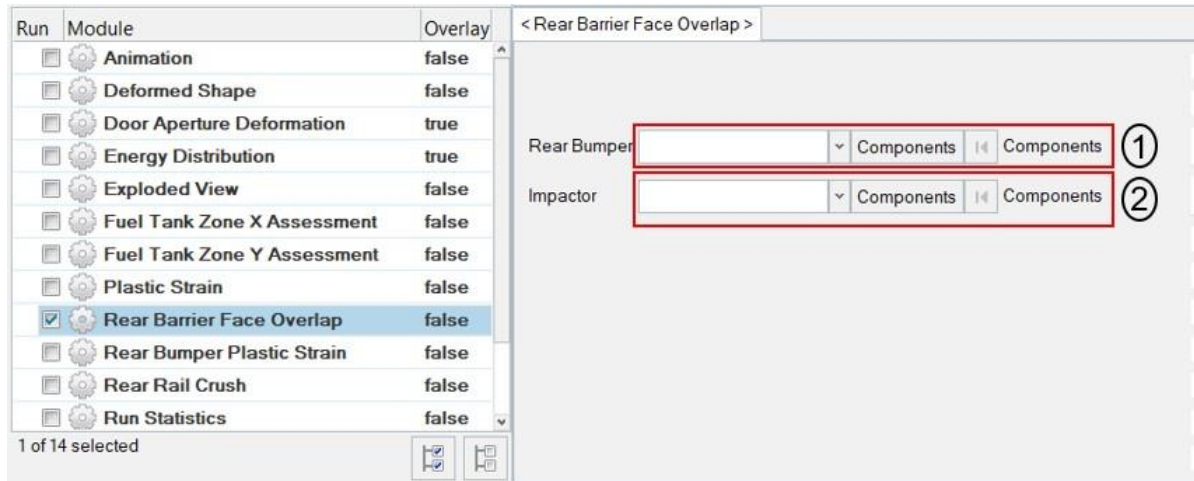
5.90E-01  
5.00E-02 ③  
4.37E-02  
3.75E-02  
3.13E-02  
2.50E-02  
1.88E-02  
1.25E-02  
6.25E-03  
0.00E+00  
No Result

Max = 5.90E-01  
Node 2072088



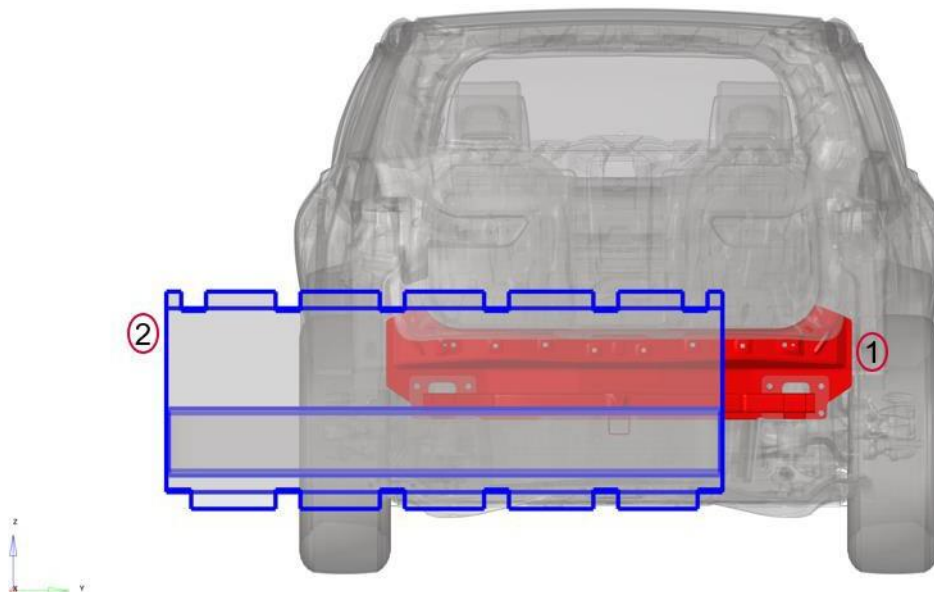
## Rear Barrier Face Overlay

Rear barrier face module lets you create an image wherein the impactor front or barrier face is positioned relative to rear bumper.



### Inputs:

- 1) Rear bumper Component IDs / Assembly IDs
- 2) Impactor Component IDs / Assembly IDs



## Rear Bumper Plastic Strain

This module is used to generate a summary report of rear bumper plastic strain contour at the user selected simulation step.

Run	Module	Overlay	< Rear Bumper Plastic Strain >
<input type="checkbox"/>	Animation	false	Tracking System N1 <input type="text"/> Node <input type="button" value="H"/> N2 <input type="text"/> Node <input type="button" value="H"/> N3 <input type="text"/> Node <input type="button" value="H"/>
<input type="checkbox"/>	Deformed Shape	false	
<input type="checkbox"/>	Door Aperture Deformation	true	
<input type="checkbox"/>	Energy Distribution	true	State <input type="text"/> Time in ms or Last
<input type="checkbox"/>	Exploded View	false	
<input type="checkbox"/>	Fuel Tank Zone X Assessment	false	Plastic Strain Limit <input type="text"/> Value
<input type="checkbox"/>	Fuel Tank Zone Y Assessment	false	
<input type="checkbox"/>	Plastic Strain	false	Rear Bumper Beam <input type="text"/> Components <input type="button" value="H"/> Components
<input checked="" type="checkbox"/>	Rear Bumper Plastic Strain	false	
<input type="checkbox"/>	Rear Barrier Face Overlap	false	Lower BIW <input type="text"/> Components <input type="button" value="H"/> Components
<input type="checkbox"/>	Rear Rail Crush	false	
<input type="checkbox"/>	Run Statistics	false	
<input type="checkbox"/>	User Defined Output	true	
<input type="checkbox"/>	Velocity Separation	true	

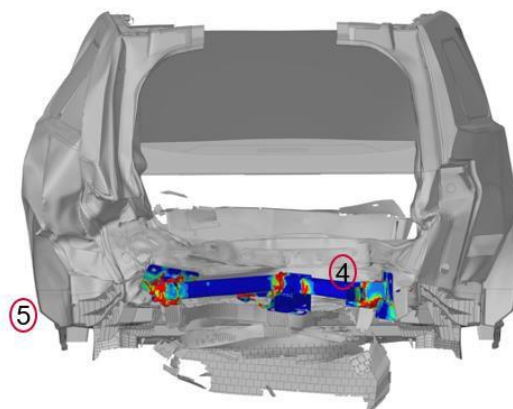
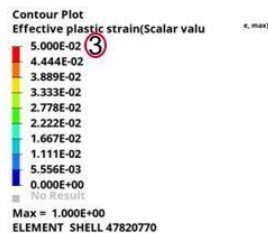
1 of 14 selected

### Inputs:

- 1) 3 nodes defining the tracking system
- 2) User selected simulation step (time in ms or Last)
- 3) Plastic strain limit
- 4) Rear bumper beam Component IDs / Assembly IDs
- 5) Lower BIW Component IDs / Assembly IDs

### Rear Bumper Plastic Strain at 55 ms

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## Rear Rail Crush

This module lets users to create a summary report of rear rail crush mode.

Run	Module	Overlay
<input type="checkbox"/>	Animation	false
<input type="checkbox"/>	Deformed Shape	false
<input type="checkbox"/>	Door Aperture Deformation	true
<input type="checkbox"/>	Energy Distribution	true
<input type="checkbox"/>	Exploded View	false
<input type="checkbox"/>	Fuel Tank Zone X Assessment	false
<input type="checkbox"/>	Fuel Tank Zone Y Assessment	false
<input type="checkbox"/>	Plastic Strain	false
<input type="checkbox"/>	Rear Barrier Face Overlap	false
<input type="checkbox"/>	Rear Bumper Plastic Strain	false
<input checked="" type="checkbox"/>	<b>Rear Rail Crush</b>	false
<input type="checkbox"/>	Run Statistics	false
<input type="checkbox"/>	User Defined Output	true
<input type="checkbox"/>	Velocity Separation	true

1 of 14 selected

< Rear Rail Crush >

Tracking System

N1

Node

N2

Node

N3

Node

State

Time in ms or Last

Impact Side Rear Rail

Components

Components

Lower BIW

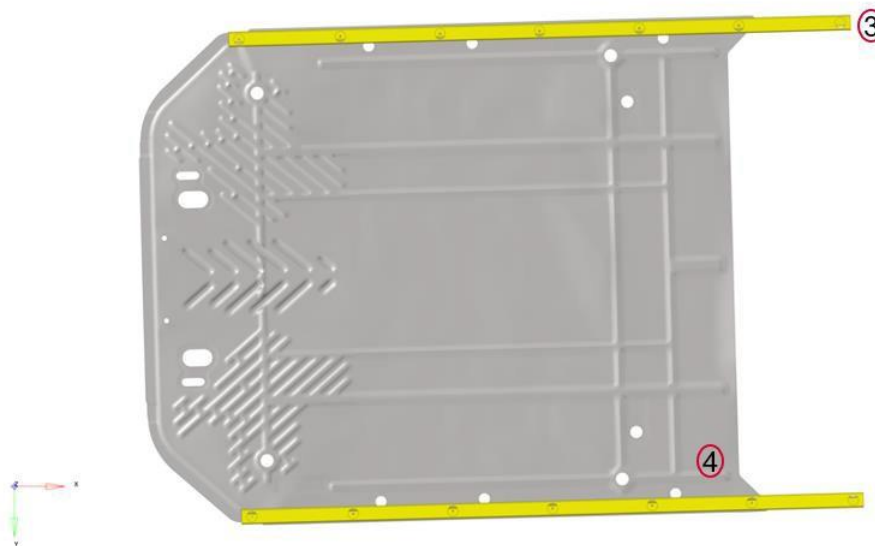
Components

Components

### Inputs:

- 3 nodes defining the tracking system
- User selected simulation step (time in ms or Last)
- Impact side rear rail Component IDs / Assembly IDs
- Lower BIW Component IDs / Assembly IDs

**r1 Rear Rail Crush at 100 ms**



## 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	Configuration
<input checked="" type="checkbox"/>	Animation	false	Model info start
<input type="checkbox"/>	Dash Intrusion Contour Plot	false	Program Name
<input type="checkbox"/>	Dash Intrusion Cross Section	true	Gateway
<input type="checkbox"/>	Deformed Shape	false	Run Description
<input type="checkbox"/>	Energy Distribution	true	Restraint Status
<input type="checkbox"/>	Engine Mount Failure	false	Body Style
<input type="checkbox"/>	Exploded View	false	Engine/Transmission
<input type="checkbox"/>	Load Path	true	Test Speed
<input type="checkbox"/>	Occupant	true	Driveline
<input type="checkbox"/>	Pedal Column Motion	true	Impactor Assembly/Component
<input checked="" type="checkbox"/>	Run Statistics	false	Front Wheel Coordinates
<input type="checkbox"/>	Structural Assessment	false	Rear Wheel Coordinates
<input type="checkbox"/>	Structural Vehicle Kinematics	false	Maximum N Curves
<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	

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 Assemblies

Front Wheel Coordinates: X: 1438, Y: -853, Z: 468 Node

Rear Wheel Coordinates: X: 4154, Y: -878, Z: 464 Node

Maximum N Curves: 10

## Model Info Summary & Run Quality Report

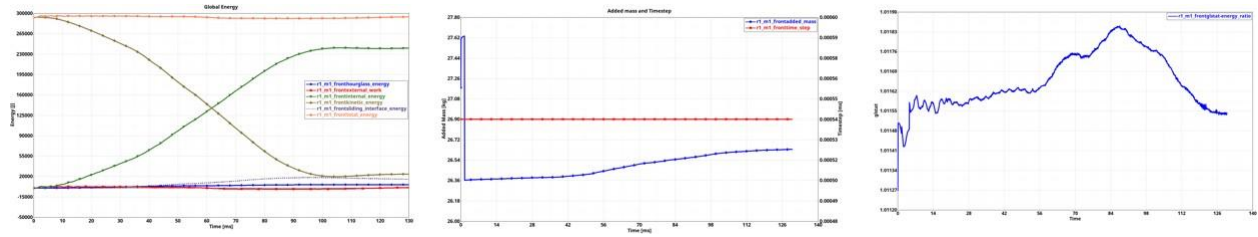
Program Name	2021_test_vehicle
Gateway	abcd
Run Description	A-Pillar with Failure EPS @ failure = 0.10%
Restraint Status	Unbelted
Body Style	Sedan
Engine/Transmission	4L V6
Test Speed	35 Kph
Driveline	FWD
Run Name	Main.k
Engineer	tejasr
Model Run Date	09/18/2021
Test Mode	Front IH5 ODB
Gross Vehicle Weight	1.65 kg
Impactor Weight	-0.00 kg
Total Weight	1.65 kg
Vehicle Front Axle Weight	0.96 kgs
Vehicle Rear Axle Weight	0.64 kgs
Solver Version	mpp v R7.1.2
Number of CPU	8 CPU
Run Time	14 hr 32 min 57 sec



Run Quality	Result	Target
Termination Time	130.0 ms	130.0 ms
Termination Type	Normal Termination	
Mass Added @ T=0 [%]	1.89 %	< 1 %
Total Mass Added [%]	1.51 %	< 3 %
Total Mass Added [kg]	27.636 kg	
Energy -> Hourglass [%]	2.525 %	< 10 %
Energy -> Ratio [%]	1.0119 %	1 >= Energy Ratio < 1.01

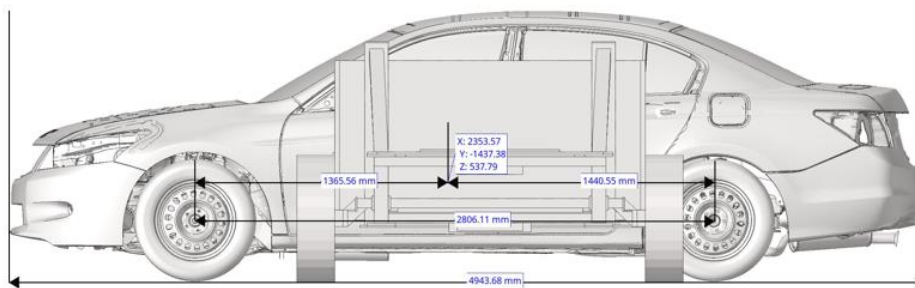


## Global Energy, Added Mass, Time Step & Energy Ratio Plots



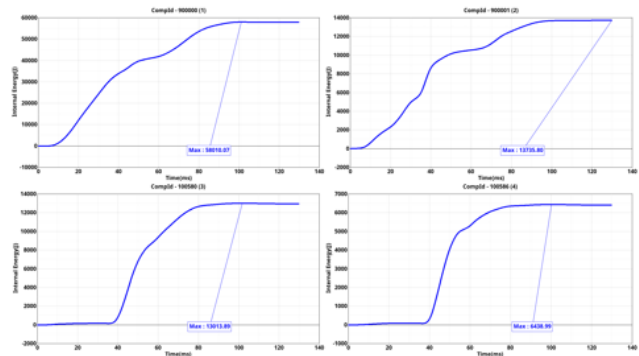
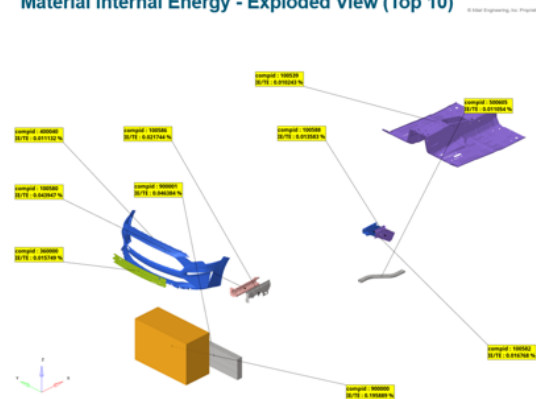
## Vehicle Mass & Geometric Measurements

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



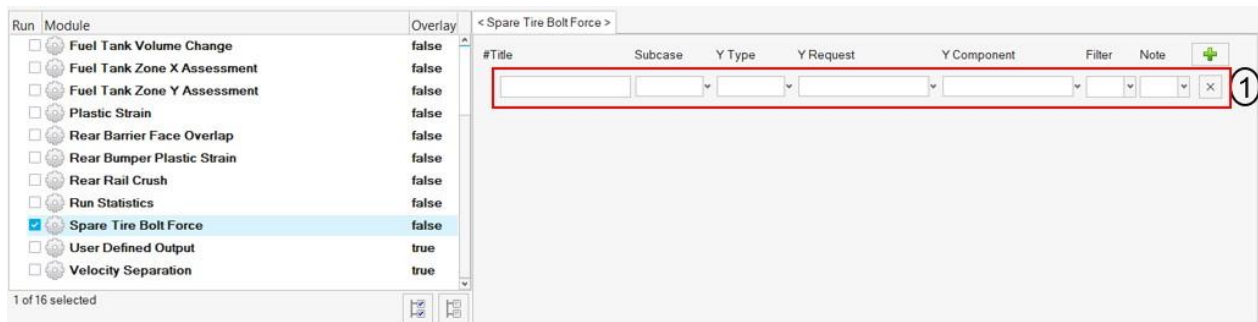
## Material Internal Energy Summary

### Material Internal Energy - Exploded View (Top 10)



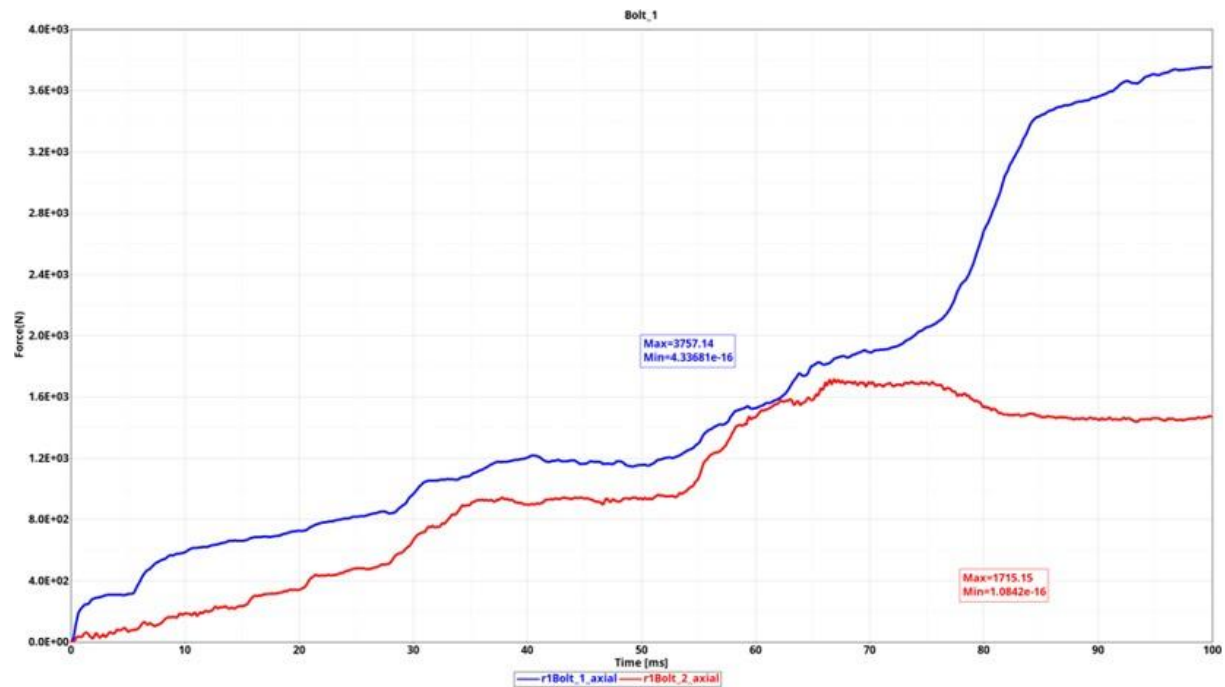
## Spare Tire Bolt Force

This module is used to plot the spare tire bolt force (axial) across the simulation time steps.



Inputs:

- 1) Enter the title for the plot
- 2) Select the subcase, Y type, Y request & Y component of bolt (beam element ID) from time history file
- 3) Select filter & note options as appropriate



## 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.

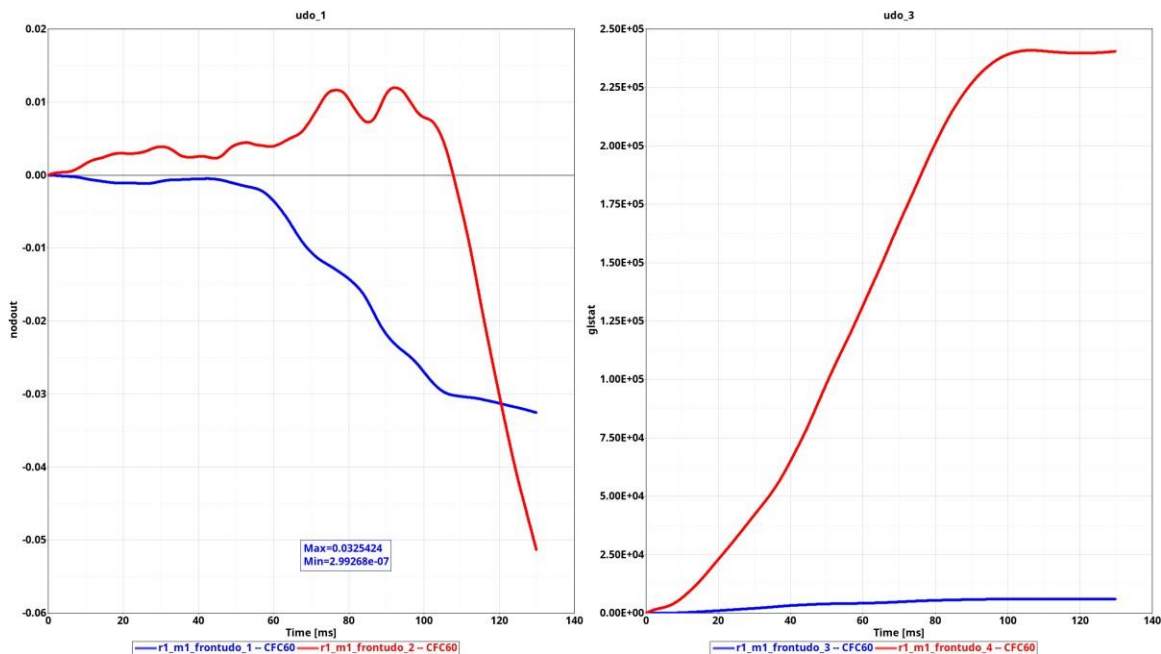
Run	Module	Overlay	Configuration									
			#Title	Subcase	Y Type	Y Request	Y Component	Filter	Note	X Axis Scale	Y Axis Scale	Window
<input type="checkbox"/>	Dash Intrusion Contour Plot	false	1	udo_1	nodout	nodout	Local1_kx_n_bpl 100	ry_displacement	CFC 60	Yes	1	1
<input type="checkbox"/>	Dash Intrusion Cross Section	true		udo_2	nodout	nodout	Local1_kx_n_bpl 100	rx_displacement	CFC 60	No	1	1
<input type="checkbox"/>	Deformed Shape	false		udo_3	glistat	glistat		hourglass_energy	CFC 60	No	1	1
<input type="checkbox"/>	Energy Distribution	true		udo_4	glistat	glistat		internal_energy	CFC 60	No	1	1
<input type="checkbox"/>	Engine Mount Failure	false		udo_5	matsum	matsum	BR-Stopper_2mm 290	x_momentum	CFC 60	Yes	1	1
<input type="checkbox"/>	Exploded View	false		udo_6	matsum	matsum	JRT-15K073-AQIBRK	z_momentum	CFC 60	Yes	1	1
<input type="checkbox"/>	Load Path	true		udo_7	rbout	rbout	1005_1	dircos_22	CFC 60	Yes	1	1
<input type="checkbox"/>	Occupant	true		udo_8	rcforc	rcforc	Vehicle200B_IHSOfs	ry_force	CFC 60	Yes	1	1
<input type="checkbox"/>	Pedal Column Motion	true		udo_9	rcforc	rcforc	SteeringColumn2Sumo	x_moment	CFC 60	Yes	1	1
<input type="checkbox"/>	Run Statistics	false		udo_10	secdorc	secdorc	Tunnel1 100050	ry_centroid	CFC 60	Yes	1	1
<input type="checkbox"/>	Structural Assessment	false										
<input type="checkbox"/>	Structural Vehicle Kinematics	false										
<input type="checkbox"/>	Structure Plastic Strain	false										
<input checked="" type="checkbox"/>	User Defined Output	true										
<input type="checkbox"/>	Vehicle Kinematics Vertical	true										
<input type="checkbox"/>	Vehicle Kinematics XY Disp	true										
<input type="checkbox"/>	Wheel Kinematics	false										

1 of 20 selected

## 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



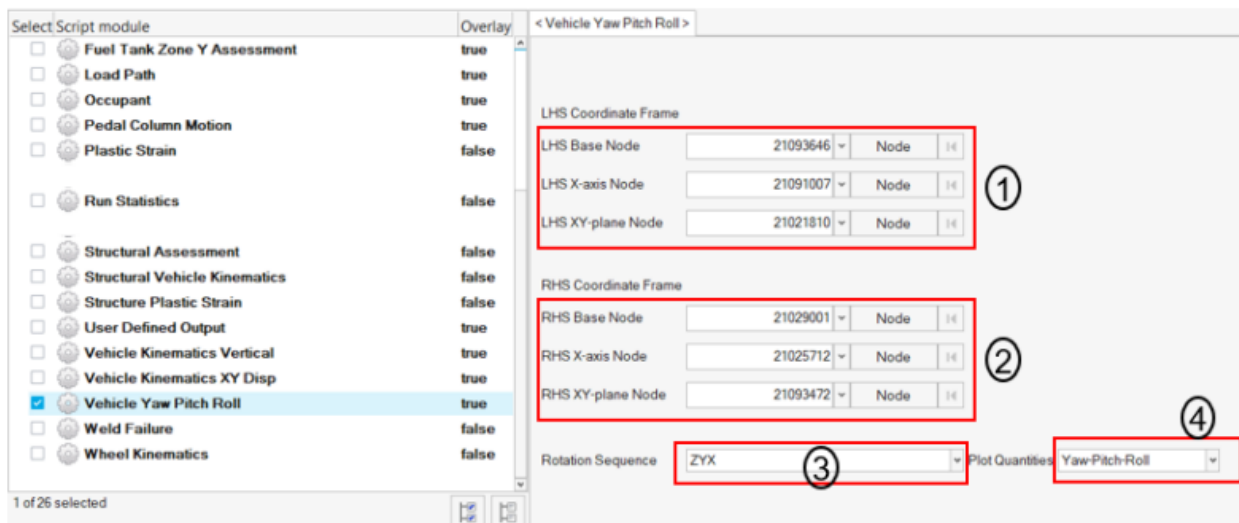


## Vehicle Yaw Pitch Roll

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)



Select Script module	Overlay
<input type="checkbox"/> Fuel Tank Zone Y Assessment	true
<input type="checkbox"/> Load Path	true
<input type="checkbox"/> Occupant	true
<input type="checkbox"/> Pedal Column Motion	true
<input type="checkbox"/> Plastic Strain	false
<input 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 checked="" type="checkbox"/> Vehicle Yaw Pitch Roll	true
<input type="checkbox"/> Weld Failure	false
<input type="checkbox"/> Wheel Kinematics	false

< Vehicle Yaw Pitch Roll >	
LHS Coordinate Frame	
LHS Base Node	21093646 Node 16
LHS X-axis Node	21091007 Node 16
LHS XY-plane Node	21021810 Node 16
RHS Coordinate Frame	
RHS Base Node	21029001 Node 16
RHS X-axis Node	21025712 Node 16
RHS XY-plane Node	21093472 Node 16
Rotation Sequence	ZYX
Plot Quantities	Yaw-Pitch-Roll

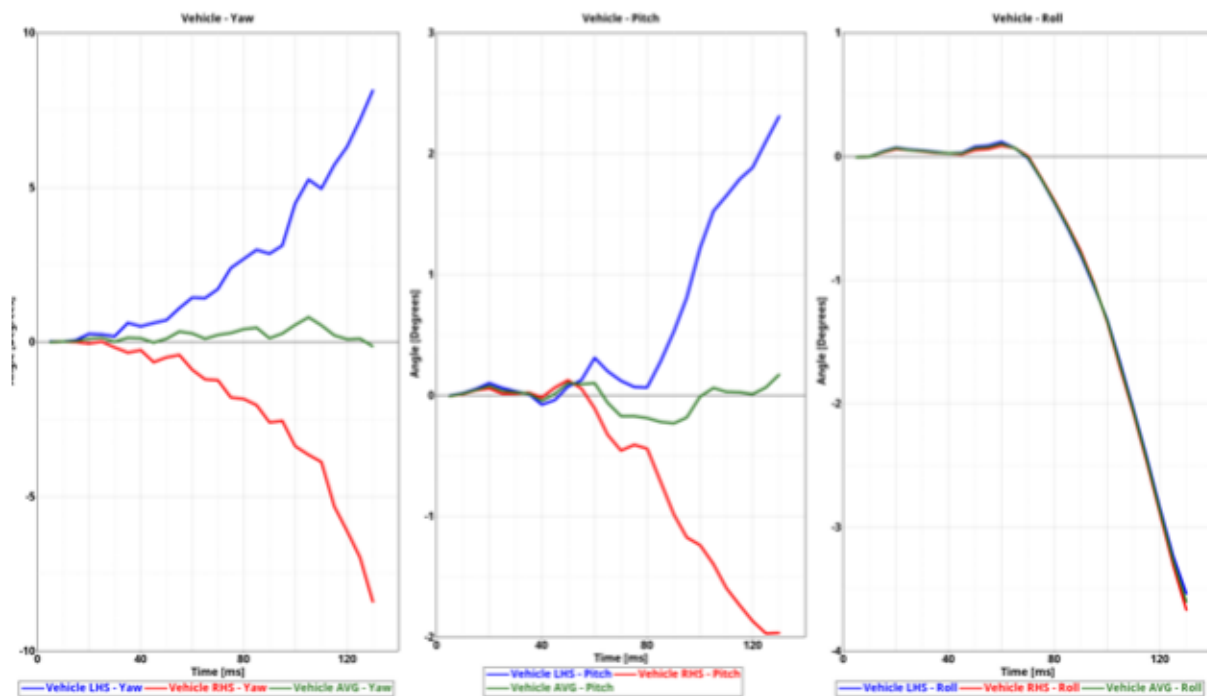
### Inputs:

- 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



## Velocity Separation

This module generates velocity plots for the selected vehicle and the barrier nodes during impact. Then finds out the time & velocity at which separation happens.

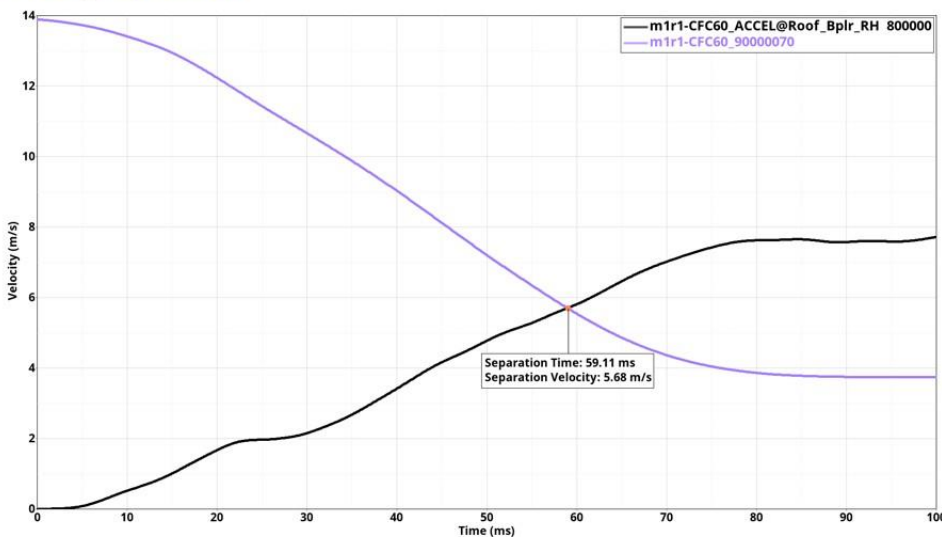
Run	Module	Overlay	Configuration
<input type="checkbox"/>	Barrier Face Overlap	false	<div>Vehicle_node <input type="text" value="800000"/> ①</div> <div>Barrier_node <input type="text" value="90000070"/> ②</div>
<input type="checkbox"/>	Deformed Shape	false	
<input type="checkbox"/>	Exploded View	false	
<input type="checkbox"/>	Load Path	true	
<input type="checkbox"/>	Occupant Side	true	
<input type="checkbox"/>	Plastic Strain	false	
<input type="checkbox"/>	Run Statistics	false	
<input type="checkbox"/>	Structural Intrusions	true	
<input type="checkbox"/>	User Defined Output	true	
<input checked="" type="checkbox"/>	<b>Velocity Separation</b>	<b>true</b>	

1 of 11 selected

### Inputs:

- 1) Vehicle node (request ID) ID from Time History file (binout)
- 2) Barrier node (request ID) ID from Time History file (binout)

## Velocity Separation



Impact Separation Time	59.11
Impact Separation Velocity	5.68

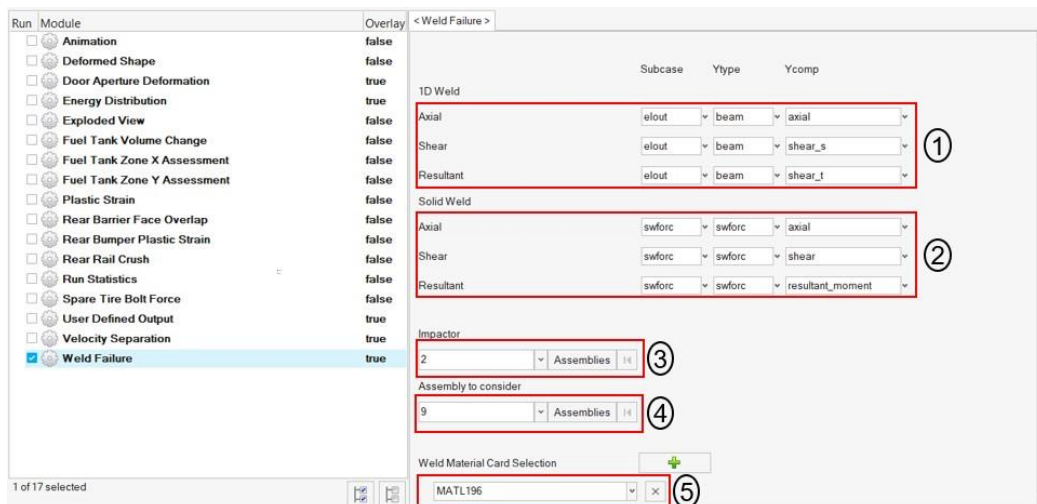
## Weld Failure

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.



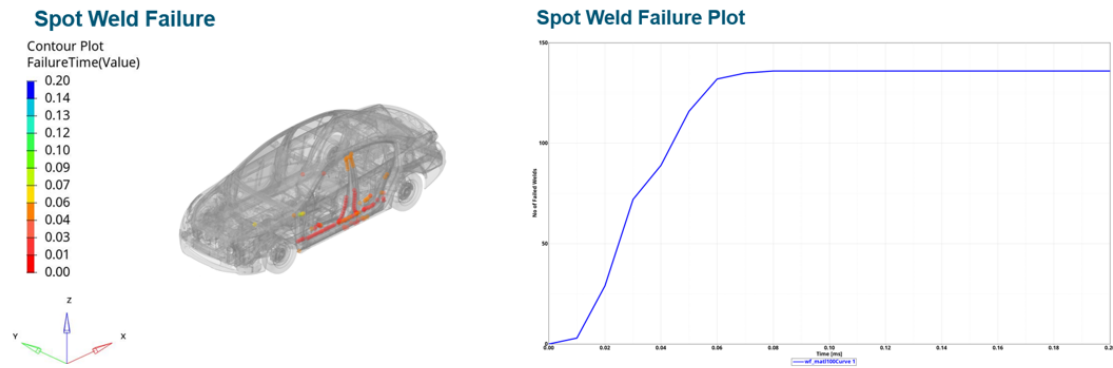
The screenshot shows the 'Weld Failure' module configuration in Altair HyperMesh. The left sidebar lists various modules, with 'Weld Failure' checked. The main panel shows the following configuration:

- 1D Weld:** Subcase (elout), Ytype (beam), Ycomp (axial) (1)
- Solid Weld:** Subcase (swforc), Ytype (swforc), Ycomp (axial) (2)
- Impactor:** (3)
- Assembly to consider:** (4)
- Weld Material Card Selection:** MATL196 (5)

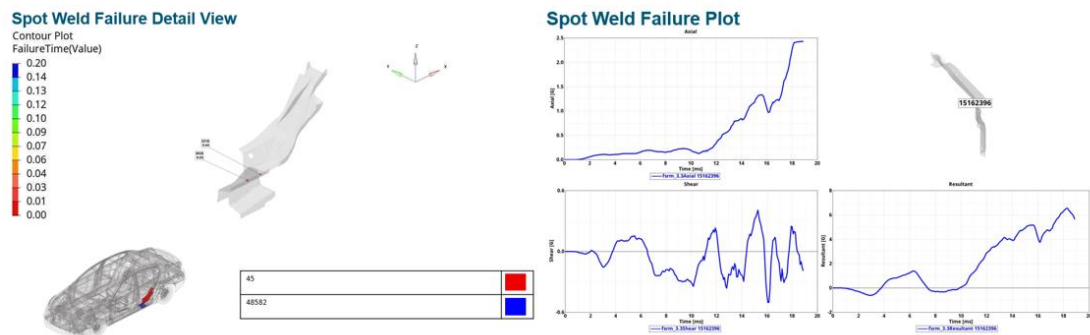
### Inputs:

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

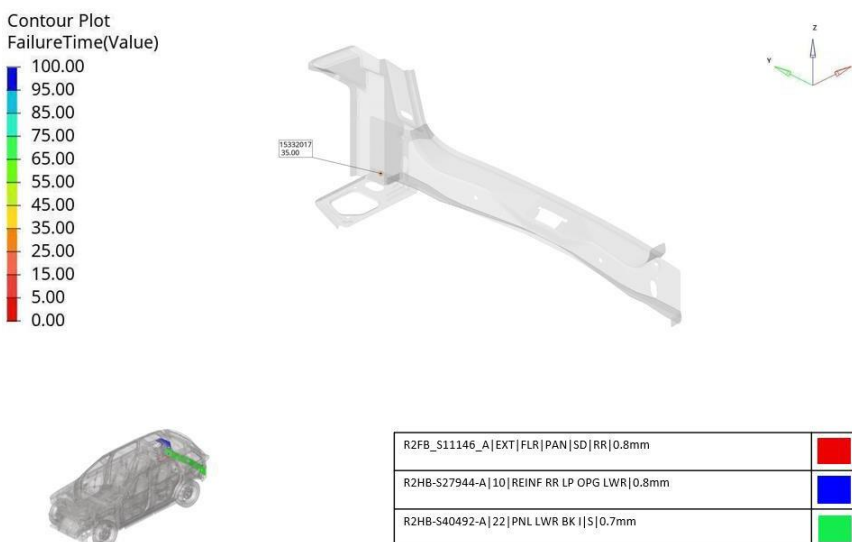
## Global viewpoint:



## 1D beam spot weld / Single hexa spot weld report



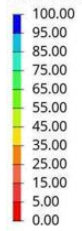
## Hexa nuggets report:



## 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