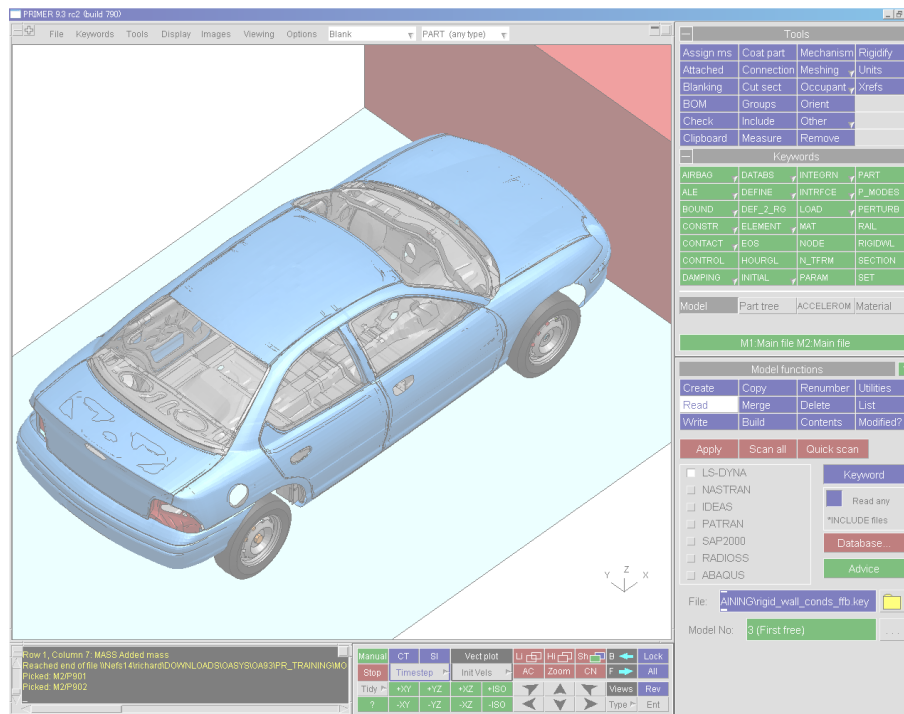


# Oasys PRIMER

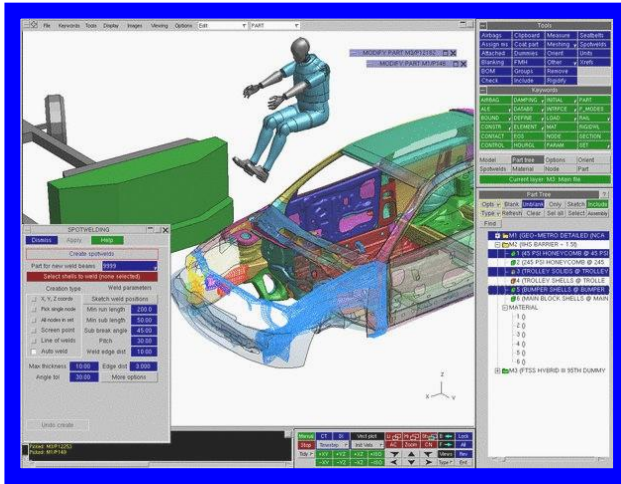
## Model Checking & QA



- Introductions.
- Purpose & overview of Oasys PRIMER.
- Focus - Model Checking and QA.
  - Core model checking tools.
  - Other PRIMER tools used for checking models.
  - Tools which maintain the model integrity.
  - Customisation of checking.
  - PRIMER integrated with post-processing tools.
- Summary.

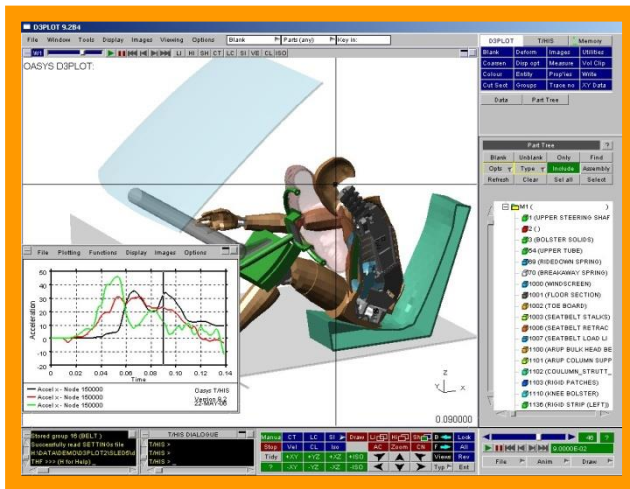
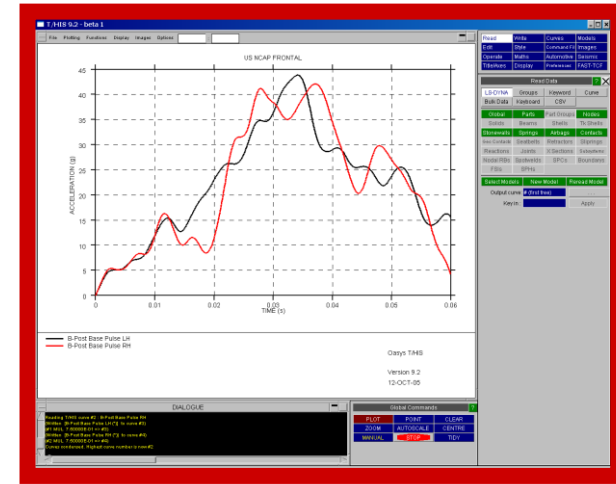
- We distribute LS-DYNA in the UK, India and China, and have over 30 years experience of working with LS-DYNA and LSTC.
- We have access to the LS-DYNA code which allows us to develop our own functionality for use by ourselves and for our clients, as well as fully understanding all LS-DYNA keyword data.
- We provide LS-DYNA support to clients around the world which helps us develop a deep knowledge of LS-DYNA, and understand the trends in it's use, as well as trends in automotive CAE.

# Oasys – The software house of Arup



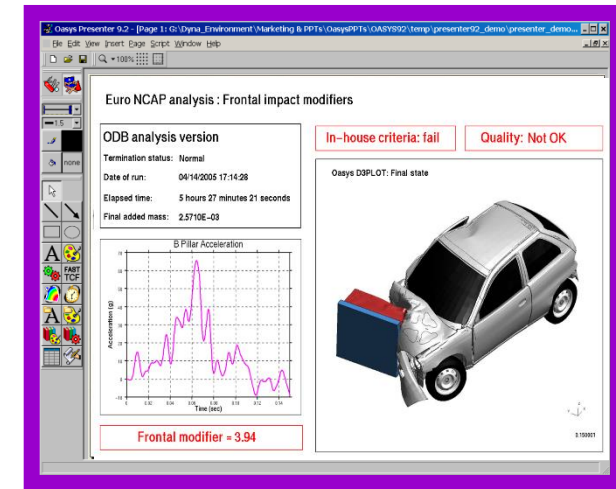
Oasys  
PRIMER

Oasys  
T/HIS



Oasys  
D3PLOT

Oasys  
REPORTER

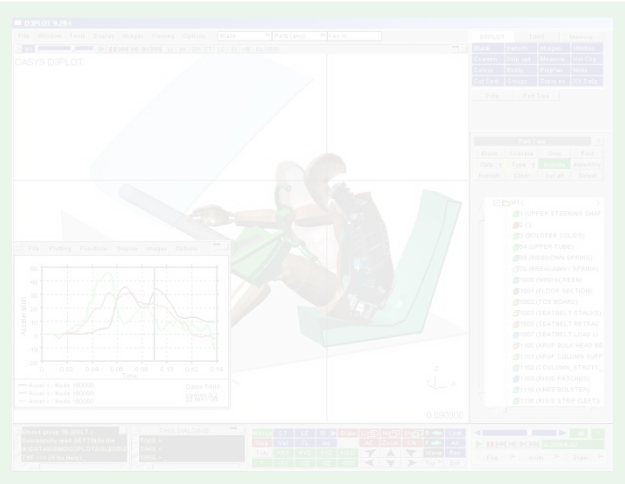


# Oasys – The software house of Arup



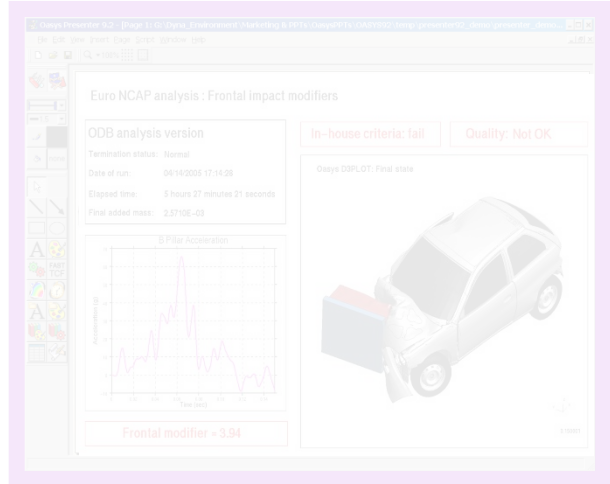
Oasys  
PRIMER

Oasys  
T/HIS



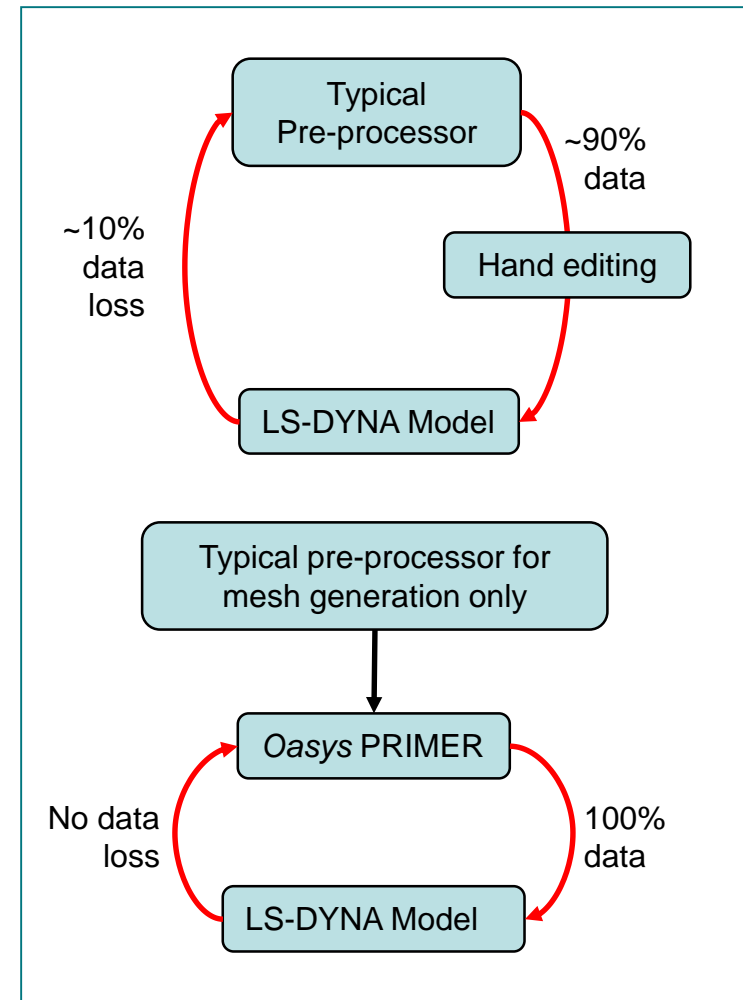
Oasys  
D3PLOT

Oasys  
REPORTER

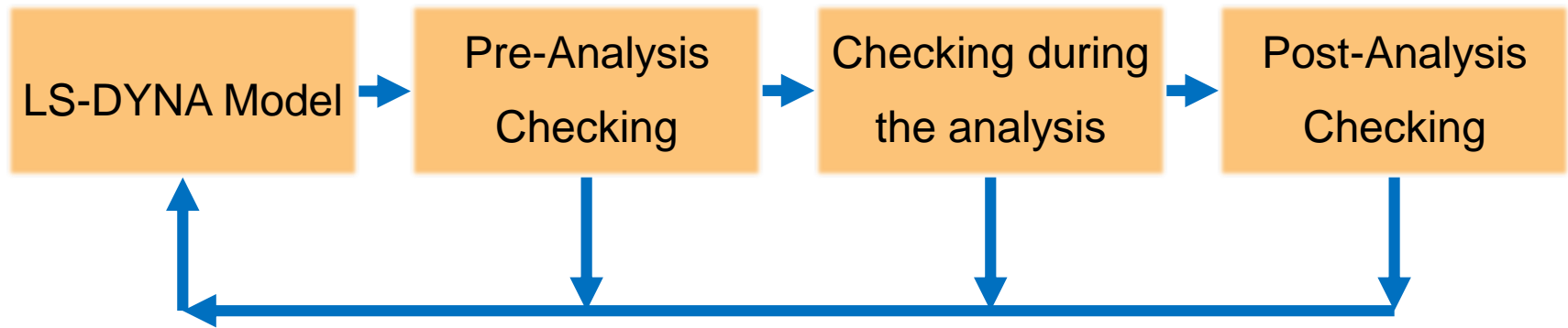


# Purpose of Oasys PRIMER

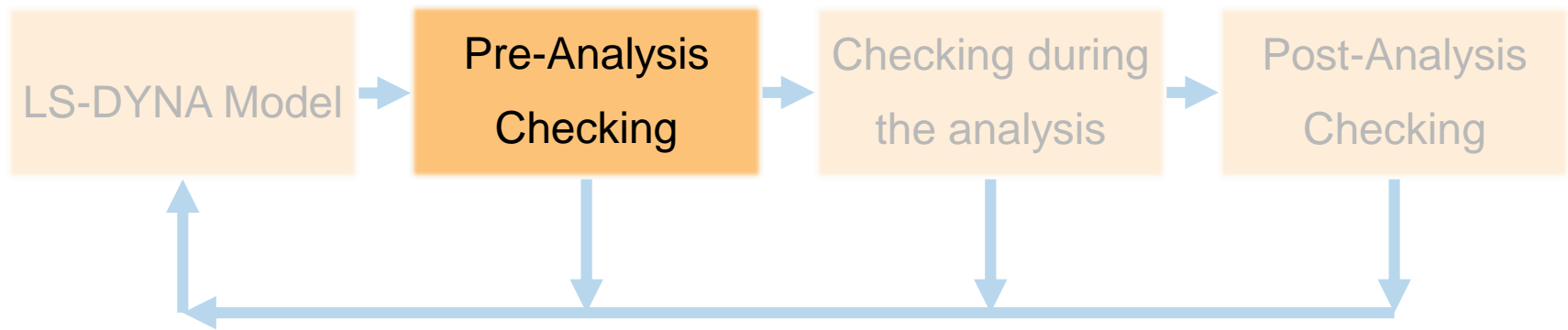
- Oasys PRIMER is a specialised pre-processor used only for LS-DYNA models.
- PRIMER's modeling tools and comprehensive error checking can reduce preparation and debugging time.
- PRIMER is fully compatible with the latest version of LS-DYNA, so no information is lost when reading, or writing out model data.
- PRIMER's model management tools allow the CAE team to work in parallel on different components of the same model.
- Because of PRIMER's robustness and depth of understanding of the LS-DYNA data, users trust PRIMER to work on their complex models without corrupting or losing any data.



# Model Checking + Ensuring the Integrity and Quality of Your Model

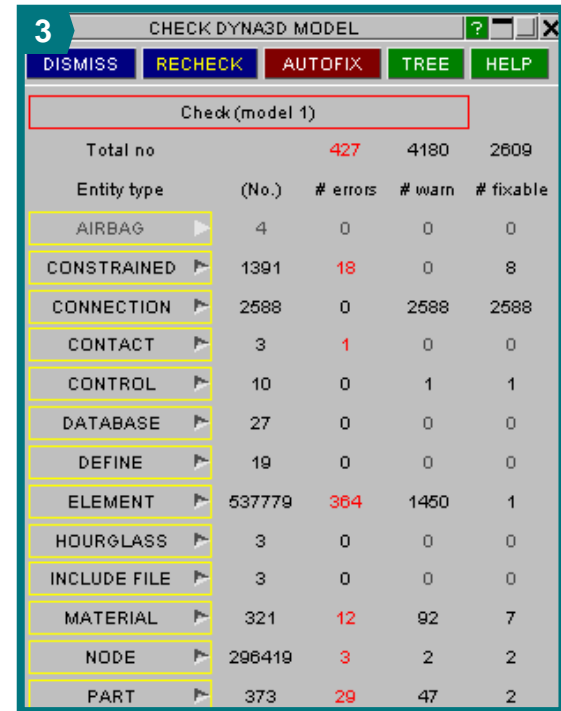
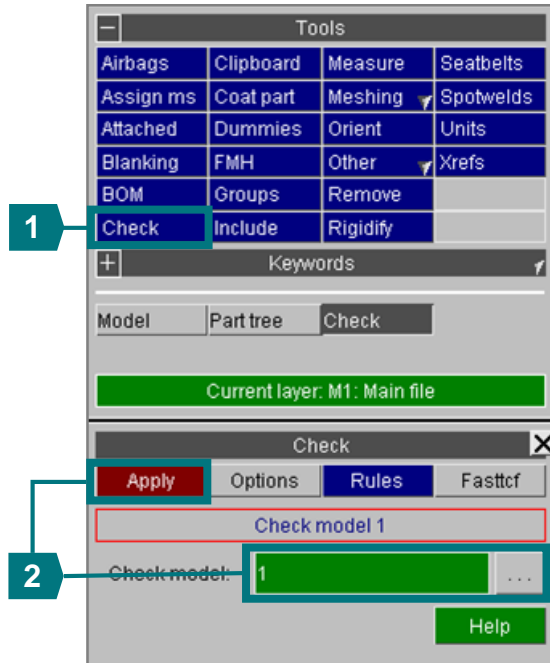






# Core Checking Features

# Checking Models



3

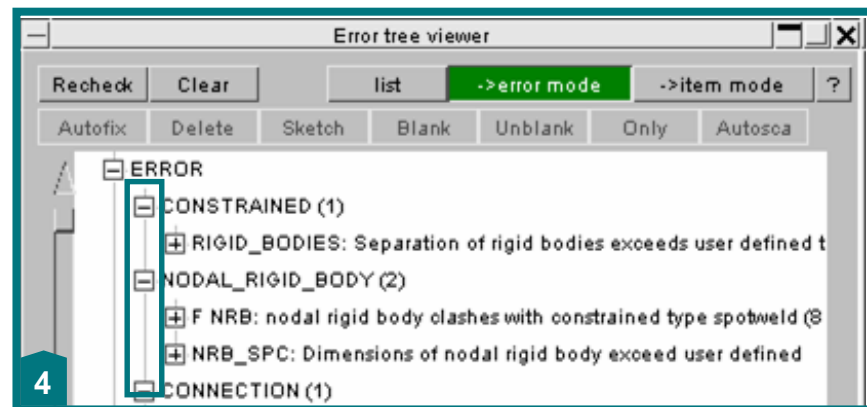
CHECK DYNA3D MODEL

DISMISS RECHECK AUTOFIX TREE HELP

Check (model 1)

Check (model 1)				
Total no		427	4180	2609
Entity type	(No.)	# errors	# warn	# fixable
AIRBAG	4	0	0	0
CONSTRAINED	1391	18	0	8
CONNECTION	2588	0	2588	2588
CONTACT	3	1	0	0
CONTROL	10	0	1	1
DATABASE	27	0	0	0
DEFINE	19	0	0	0
ELEMENT	537779	364	1450	1
HOURGLASS	3	0	0	0
INCLUDE FILE	3	0	0	0
MATERIAL	321	12	92	7
NODE	296419	3	2	2
PART	373	29	47	2

PRIMER has over 7000 individual checks



# Checking Models

Recheck Clear show tags list ->error mo

Autofix Delete Sketch Blank Unblank Only Autosca

- ERROR
  - CONSTRAINED (1)
    - RIGID\_BODIES: Separation of rigid bodies exceeds user defined toler **User-defined check to catch possible modelling error**
  - NODAL RIGID BODY (2)
    - F NRB: nodal rigid body clashes with constrained type spotweld (8) **"multiple constraint" error**
    - NRB\_SPC: Dimensions of nodal rigid body exceed user defined maxir **User-defined check to catch possible modelling error**
  - CONNECTION (1)
    - Connection is invalid (77) **Faults with connections can be fixed using Connections Table**
  - CONTACT (1)
    - Constrained type SPOTWELD contact does not allow rigid parts (1) **"multiple constraint" error**
  - DEFINE\_CURVE (1)
    - Load-curve referenced but not defined (1) **Missing data – will stop LS-DYNA**
  - BEAM (1)
    - spotweld is too close to another on same part (351) **(Spotweld beam) quality checks**
  - MATERIAL (3)
    - MAT\_24/123: <LCSS> curves starts at yield stress  $Y \leq 0.0$  (4)
    - MAT\_24/123: <LCSS> curve does not begin at strain  $X = 0.0$  (6)
    - MAT\_24/123: table curves cross at strain  $< EPPF$  (1)
  - NODE (2)
    - node on rigid part clashes with constrained type spotweld (3) **"multiple constraint" error**
    - F node is not in same include as element (2)

# Checking Models

Recheck Clear show tags list ->error mode ->item m

Autofix Delete Sketch Blank Unblank Only Autosca

ERROR

WARNING

CONTROL (1)

F SHELL: Sorting flag for degenerate quads <itrist/esort> is not = 1 (1)

Recommended parameter is not the default

BEAM (3)

(spotweld) beam length is greater than maximum allowed size (1014)

(Spotweld beam) element quality checks

Beam is part of a spotweld which is longer than maximum allowed length (361)

(spotweld) beam length is less than minimum allowed size (74)

SHELL (1)

F Duplicate Shell - overlaps existing shell of same part (1)

MATERIAL (2)

F MAT\_24/123: yield stress from <LCSS> curve over rules SIGY (6)

Material type 24 - warnings

MAT\_24/123: curve discretisation may lose data (86)

PART (4)

elements of rigid part are not continuously meshed (32)

Discontinuous rigid body – could be a mistake?

F Part contains elements in different include file (1)

Model badly organised

%age added mass on part exceeds allowed percentage (12)

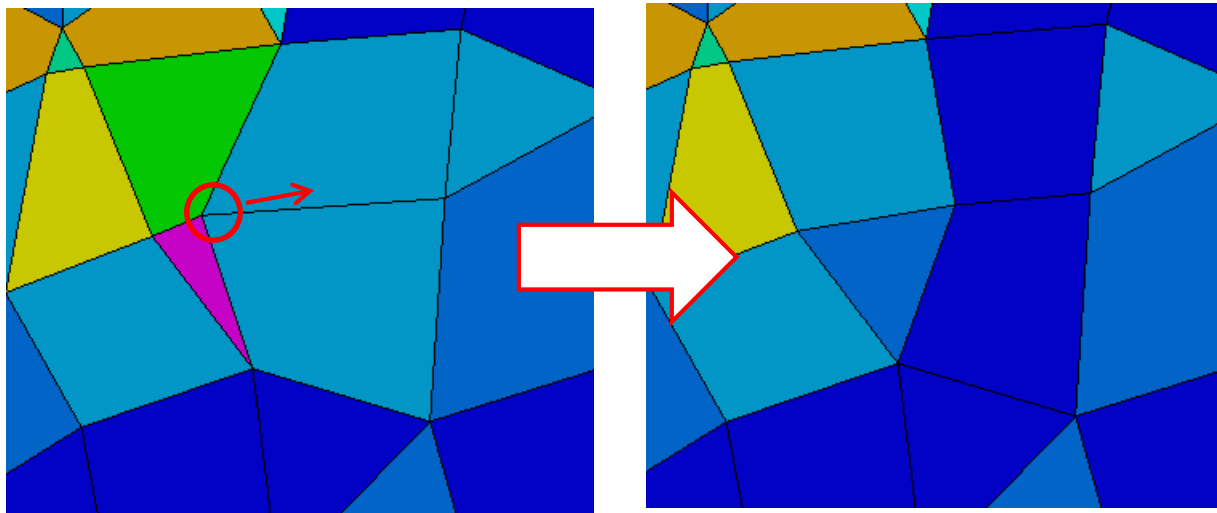
%age added mass on spotweld part exceeds allowed percentage (2)

User-defined quality check – mass-scaling

# Mesh Quality

# Meshing Quality Tools

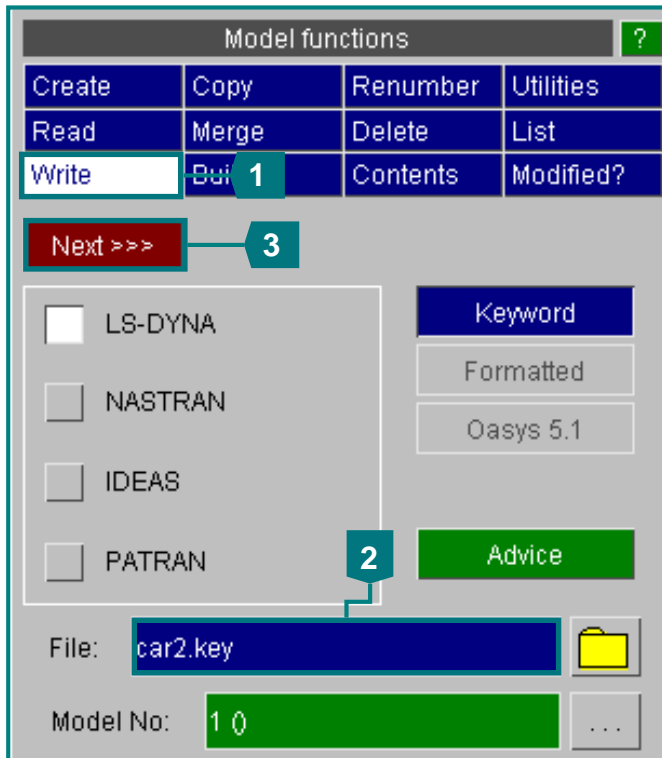
- Various meshing quality tools are available in PRIMER:
  - Check for elements that don't meet specified criteria.
  - Contouring of elements according to quality, and also contouring of elements that fail the specified criteria.
  - Moving nodes, both manually and automatically to improve element quality.
  - Ability to split and combine elements, and also to check and align normals.



# Writing out a model

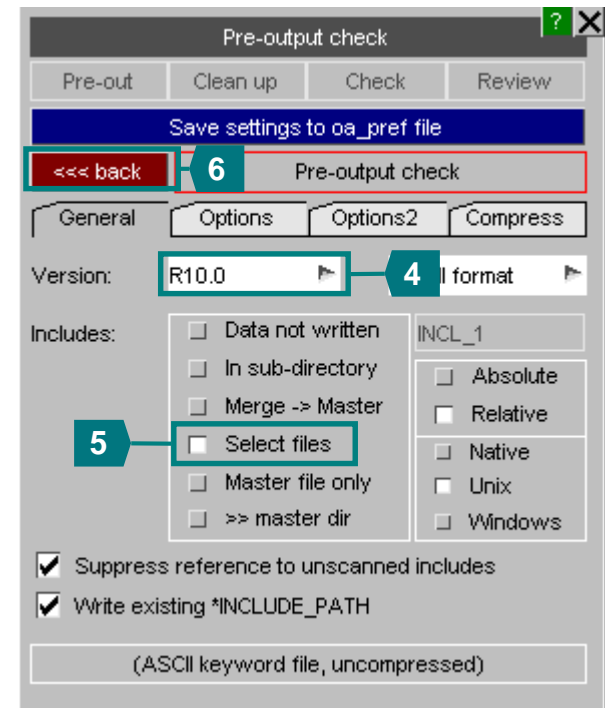


# Writing out the corrected model



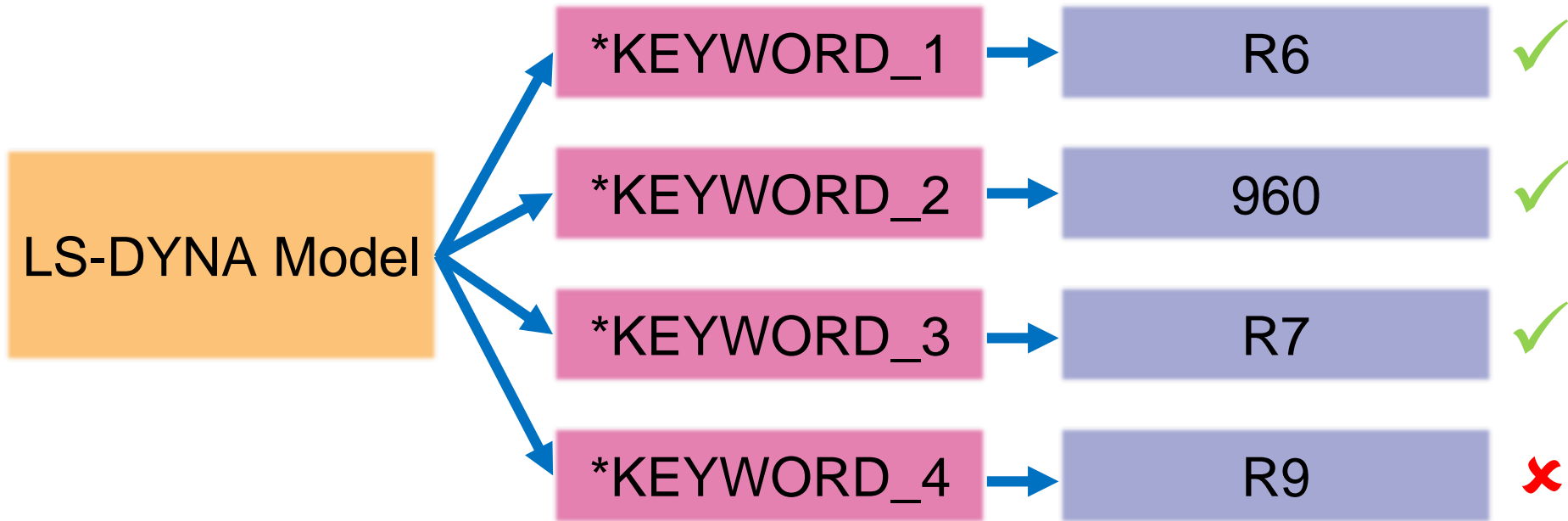
## Model Write:

1. To write out the model, use **Write** from the main model menu.
2. Give a file name. *As the model has INCLUDE files, this will be the master keyword file.*
3. Press **Next >>>** to move to the next menu
4. Set the desired **Version** of LS-Dyna. *Input data not valid for this version (e.g. new KEYWORDS) will be omitted and a warning message printed.*
5. Pick the **Select Files** option – to choose which INCLUDE files are written in the next step
6. After selecting all the required options, press **Apply**



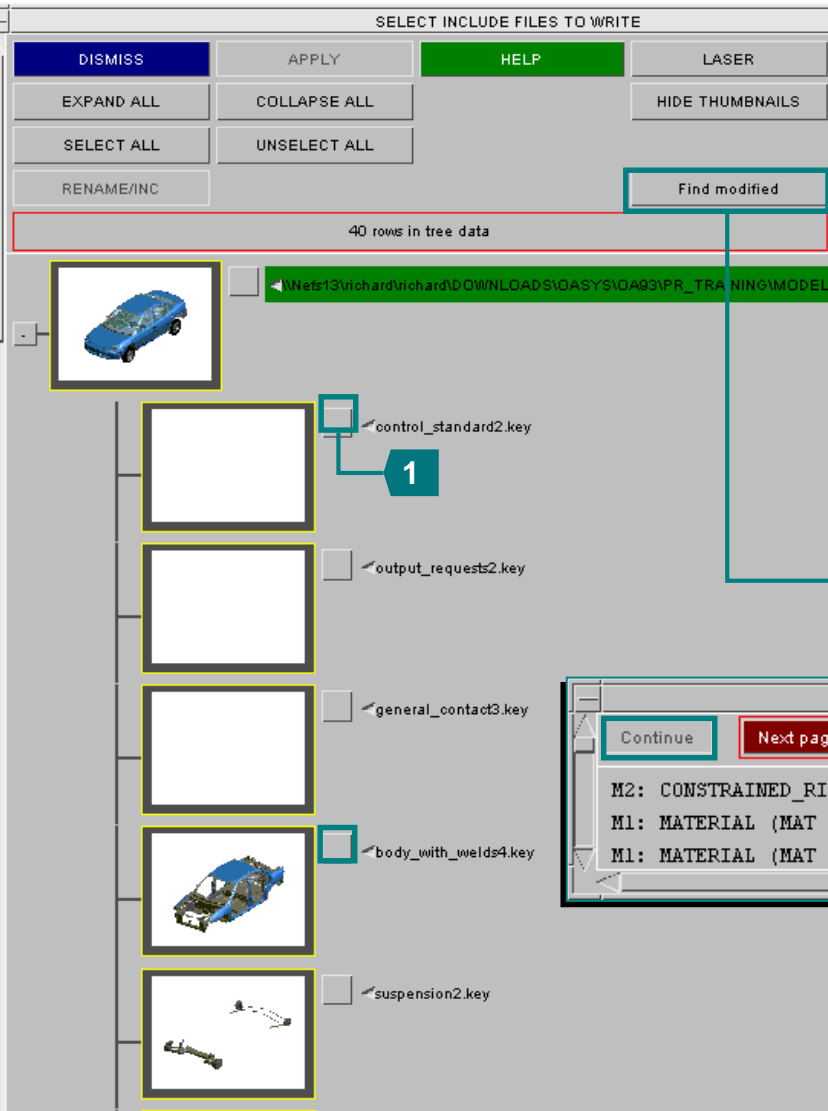
# Writing out the corrected model

Running model in R7.1.3, LS-DYNA will likely not run



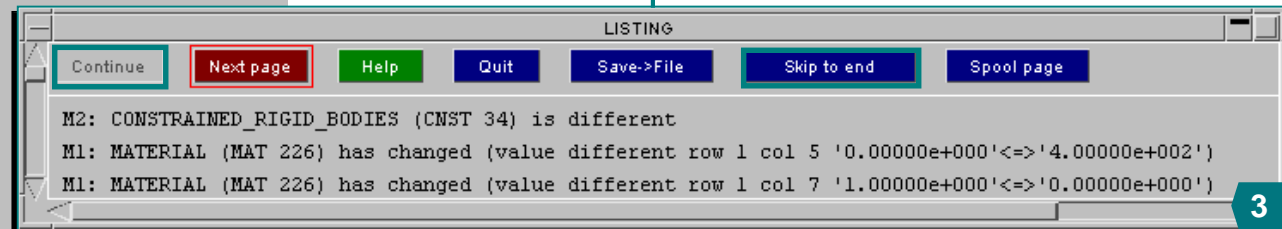
Version keyword was introduced into LS-DYNA

# Writing out the corrected model



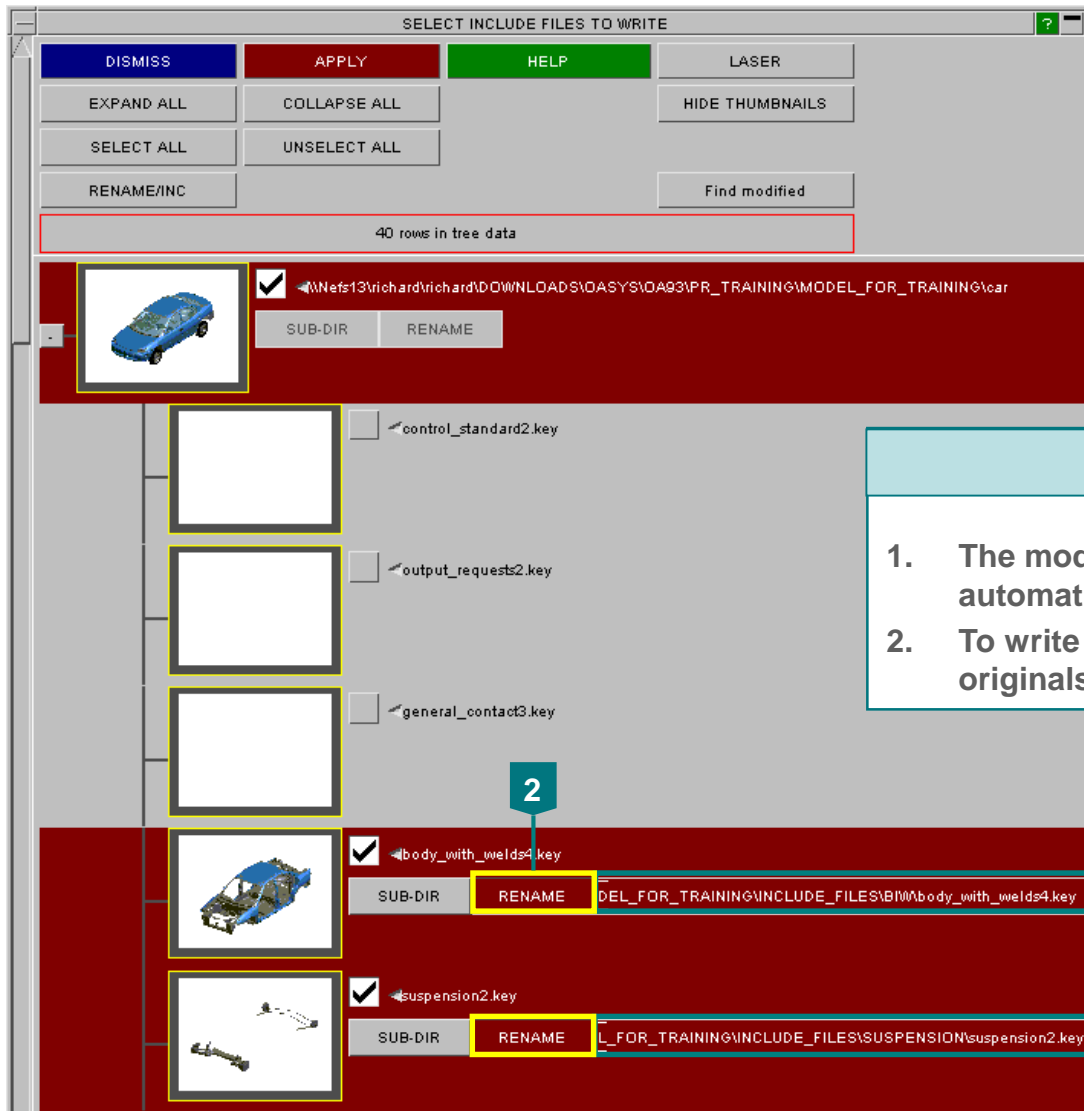
## Model Write contd.:

1. Either click the boxes to tell PRIMER which INCLUDE files to write...
2. ... or ask PRIMER to **Find modified** INCLUDE files. *This process will take one or two minutes as PRIMER compares with the files previously read off disk.*
3. PRIMER will show a list of all the changes you've made in this session. **Skip to the end** of the listing then **Continue** to the next menu



*This list may be slightly different – depending on what modifications you've made*

# Writing out the corrected model



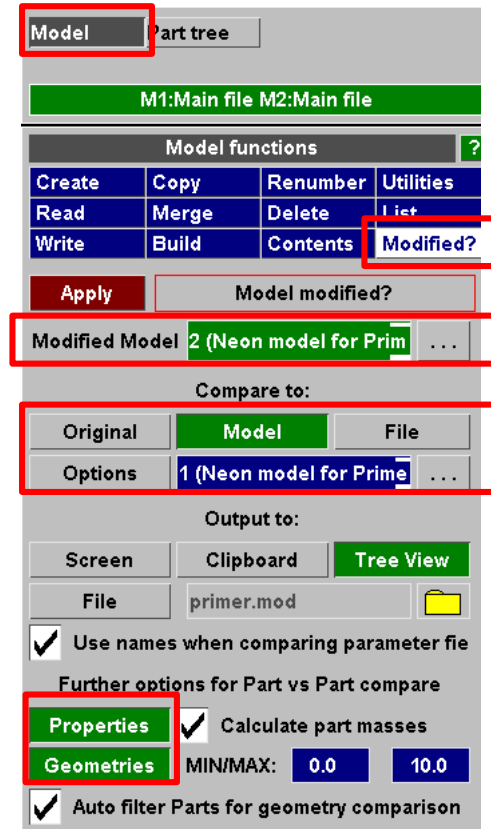
## Model Write contd.:

1. The modified INCLUDE files are shown in red & automatically selected .
2. To write the new files in the same directory as the originals, use **RENAME** and give a new file name.

# Model modified

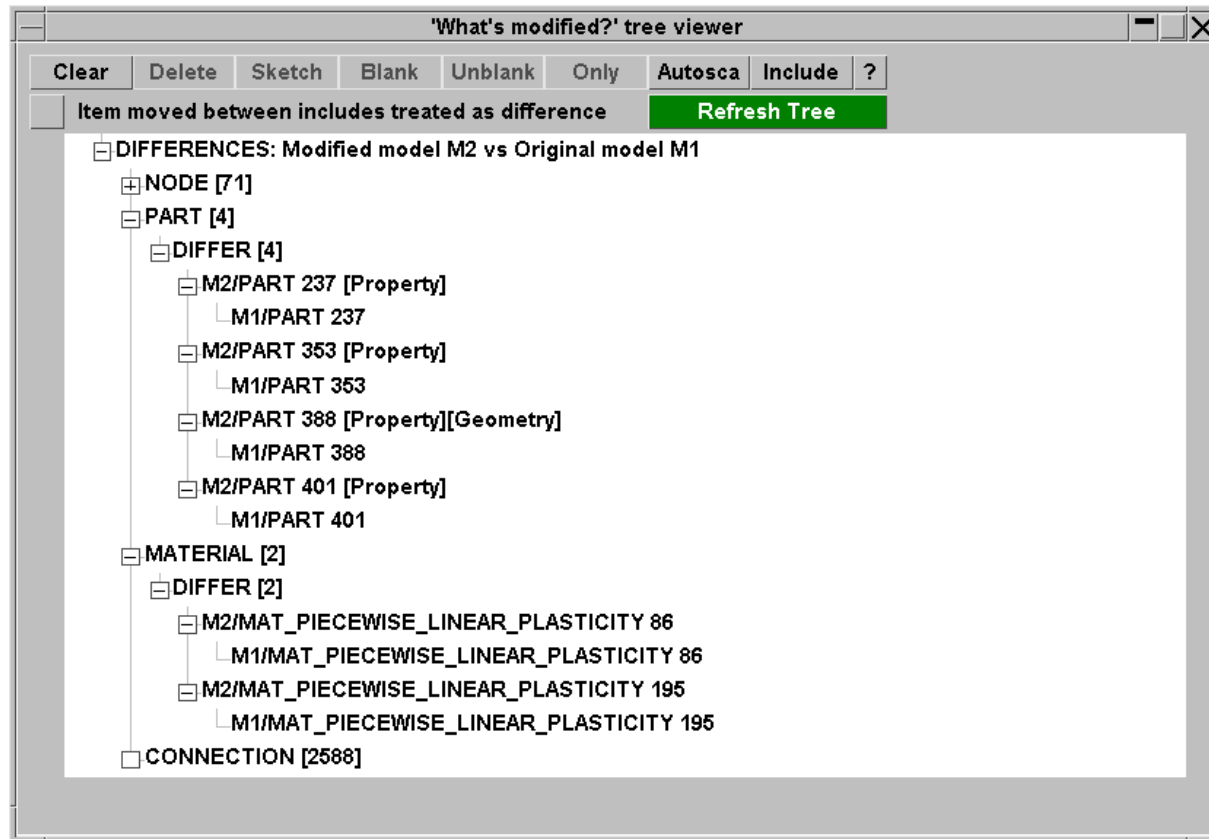
# Model modified

- Often, it is useful to see differences between models



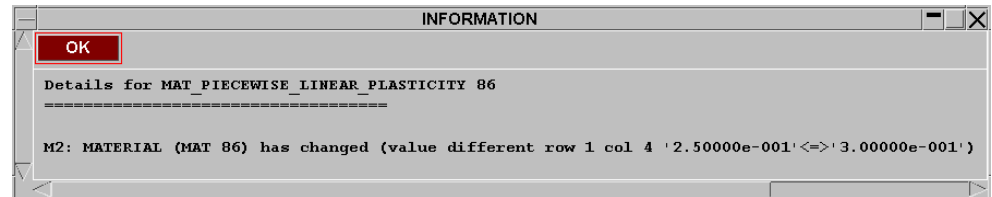
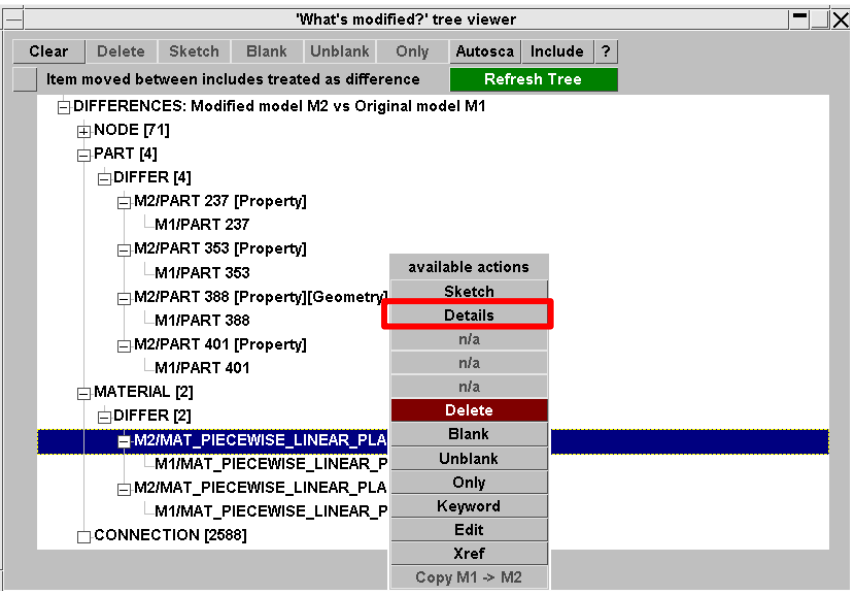
# Model modified

- Differences between the two models are shown in a tree view.
- PRIMER gives you information about differences in keywords, as well as additions/subtractions of entities between models.



# Model modified

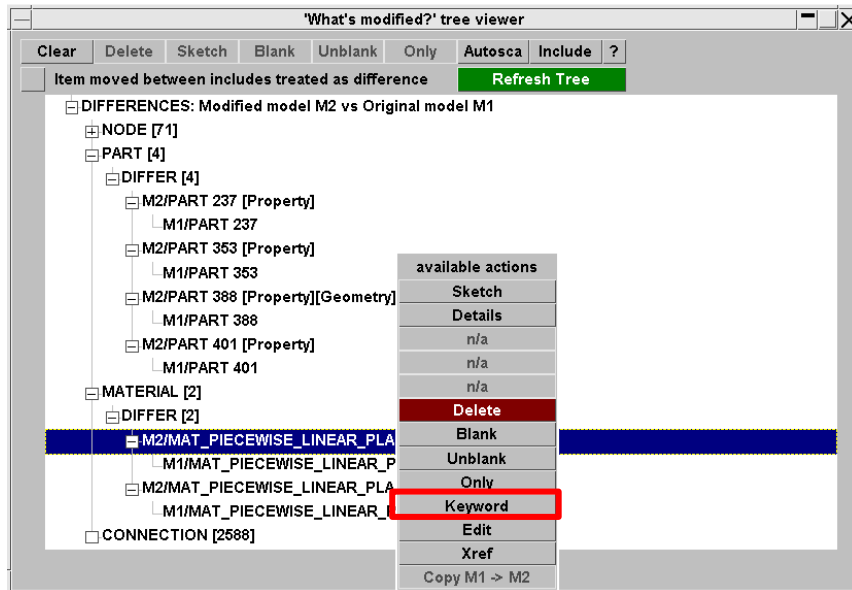
- Various options are available when right mouse clicking on one of the differences:
  - **Details** will print details of the differences found.





# Model modified

- Various options are available when right mouse clicking on one of the differences:
  - **Keyword** will display keyword panels highlighting the differences between the two cards.



Keyword: M2/MATERIAL

Buttons: CANCEL, RESET\_ALL, HELP, UPDATE, CHECK\_ALL, SKETCH\_ALL

Keyword M2 MATERIAL (1/0 mod)

Filter by: MAT <auto> <auto> <auto>

#	Options..	Incl	Suffices	MID	La	RO	F	E	F	PR	F	SIGY	F	ETAN	F	FAIL	F	TDEL	F
				C	F	P	F	LCSS	F	LCSR	F	VP	F						
				EPS1	F	EPS2	F	EPS3	F	EPS4	F	EPS5	F	EPS6	F	EPS7	F	EPS8	F
				ES1	F	ES2	F	ES3	F	ES4	F	ES5	F	ES6	F	ES7	F	ES8	F
48				misc_*MAT_02	86	7.89E-9		210000.0		0.25		250.0		0.0		0.0		0.0	
					0.0	0.0		5		0		0.0						0.0	
					0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
					0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	

Keyword: M1/MATERIAL

Buttons: CANCEL, RESET\_ALL, HELP, UPDATE, CHECK\_ALL, SKETCH\_ALL

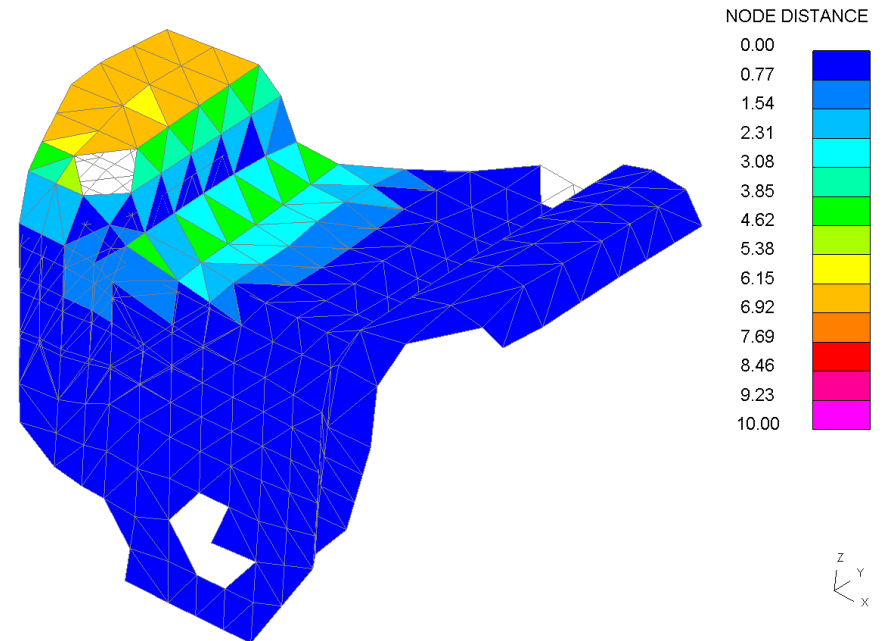
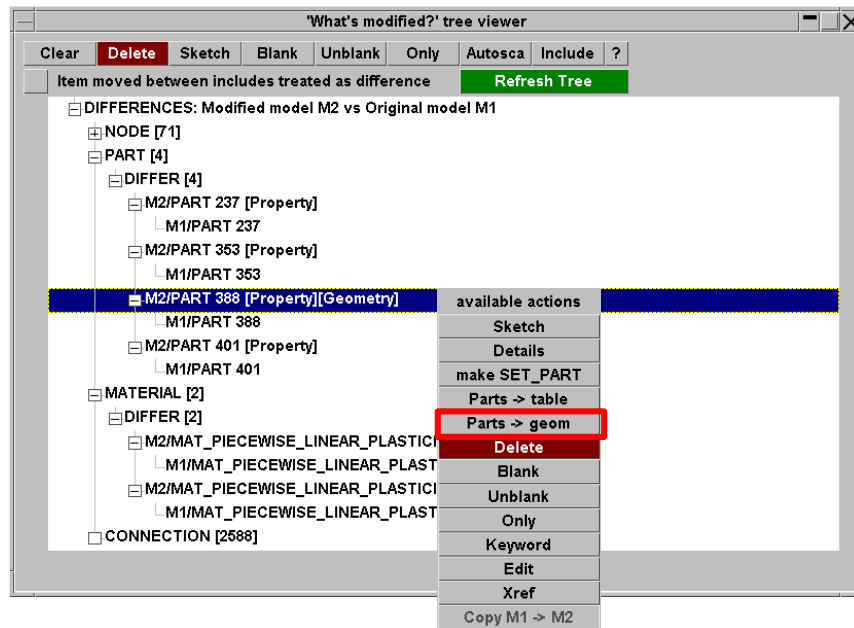
Keyword M1 MATERIAL (1/0 mod)

Filter by: MAT <auto> <auto> <auto>

#	Options..	Incl	Suffices	MID	La	RO	F	E	F	PR	F	SIGY	F	ETAN	F	FAIL	F	TDEL	F
				C	F	P	F	LCSS	F	LCSR	F	VP	F						
				EPS1	F	EPS2	F	EPS3	F	EPS4	F	EPS5	F	EPS6	F	EPS7	F	EPS8	F
				ES1	F	ES2	F	ES3	F	ES4	F	ES5	F	ES6	F	ES7	F	ES8	F
48				misc_*MAT_02	86	7.89E-9		210000.0		0.3		250.0		0.0		0.0		0.0	
					0.0	0.0		5		0		0.0						0.0	
					0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
					0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	

# Model modified

- Various options are available when right mouse clicking on one of the differences:
  - Geometry differences between parts can also be checked and contoured.



# Contact Penetration Checking and Fixing

# Penetration checking

## Contact Penetrations:

1. “Penetration” means that a node is too close to an element, i.e. within the contact thickness defined by  $0.5(t_1+t_2)$ , where  $t_1$  and  $t_2$  are the contact thicknesses of the contacting elements
2. “Crossed edge” means an intersection of one element plane with another
3. PRIMER understands the different methods of defining contact thickness, e.g. SST on \*CONTACT, or on \*PART\_CONTACT.
4. PRIMER tries to use the same equations as LS-DYNA to determine penetrations.

PEN CHECK M1/CONT2

Dismiss Check all Options...

List Errors Check visible

All segments of contact checked

2 AUTOMATIC\_SINGLE\_SURFACE  
<No title defined>

select parts sel none sel all sel xedge ?

P8231:P8710 (5 x-edges 6 pens)  
P8710:P82151 (0 x-edges 108 pens)  
P8712:P82151 (0 x-edges 76 pens)

penetrations magnitude  $\geq$  0.0

sketch unblank recursive

contour penetrating

CT SI WIRE

Settings... Levels... FIX

Pen: 190 vis 190 total  
X'ed: 5 vis 5 total  
Min: 3.2391e-002  
Max: 1.1148e+000  
Sum: 4.9069e+001

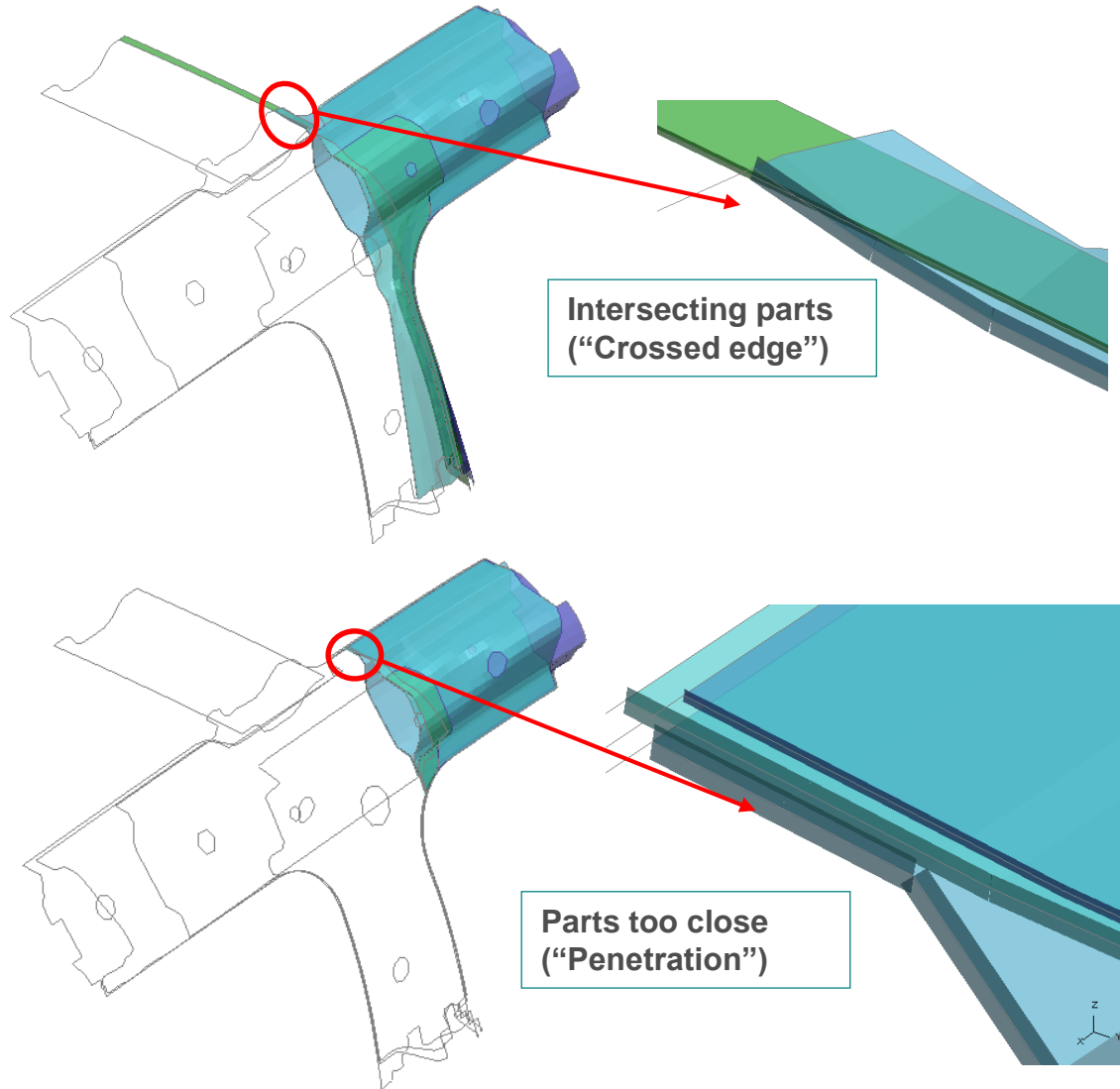
>-warnings.k Element detail Beams on x-edge

# Penetration checking

**PRIMER can check for contact penetrations and crossed edges.**

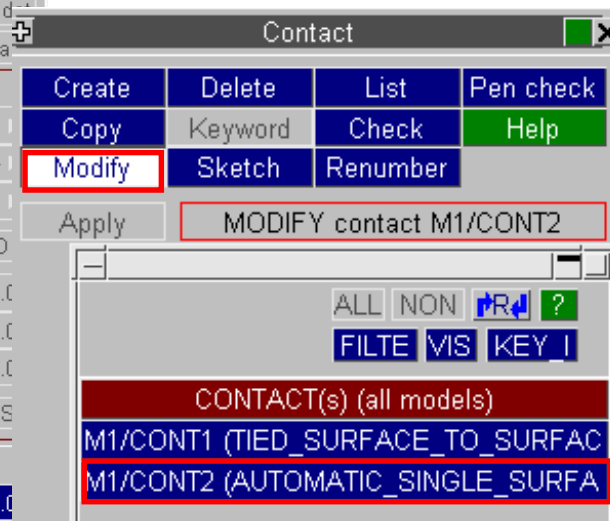
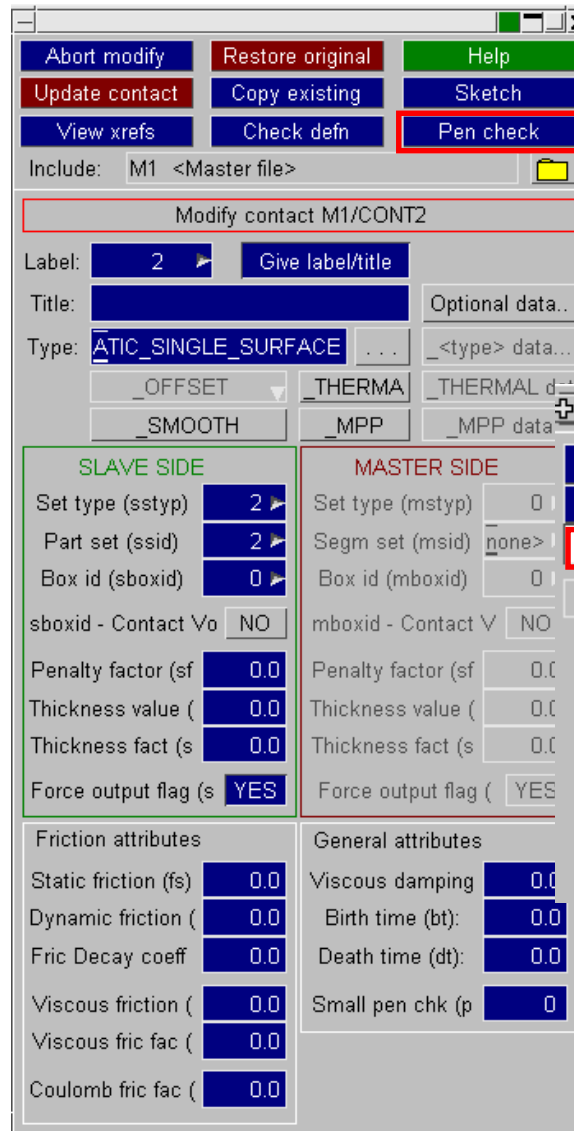
**Crossed edges are when we have intersecting parts.**

**Penetrations are when parts/elements are too close.**

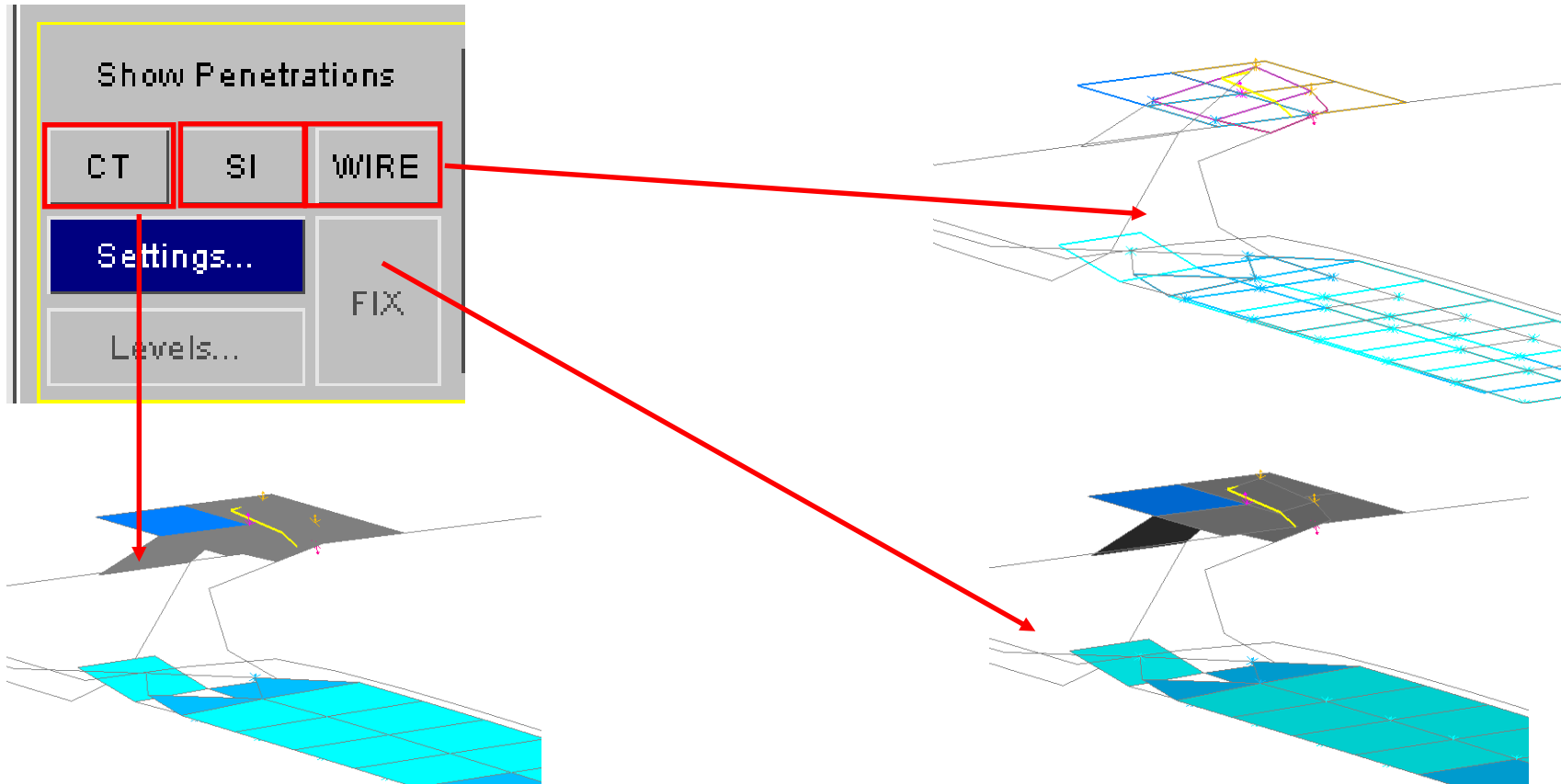


# Penetration checking

Start the Contact Penetration checker from  
Keyword=>Contact=>Sliding&Tied=>  
Modify (select the Automatic Single  
Surface contact) =>Pen Check



# Penetration checking

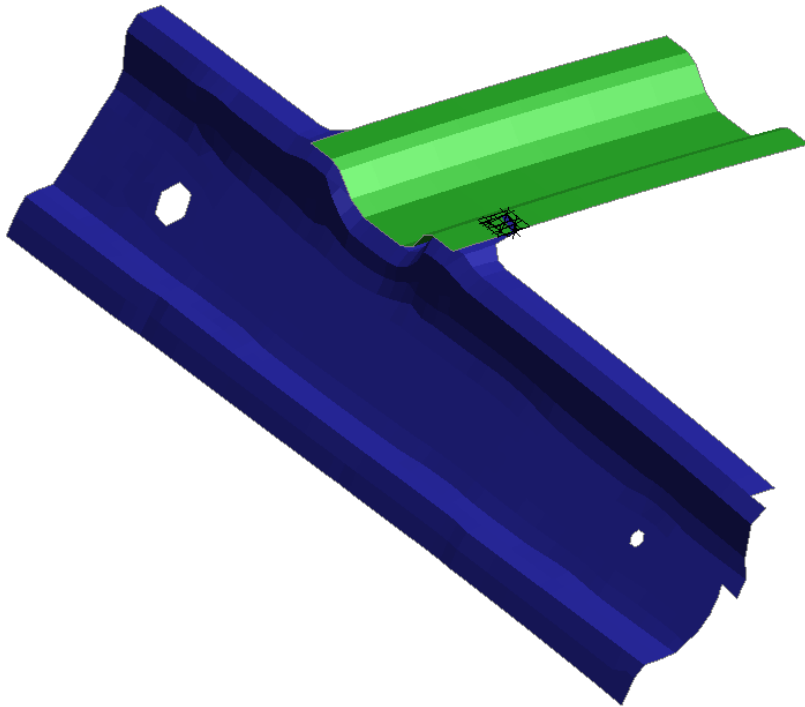


Crossed edges are shown by yellow lines on grey elements.

Penetrated elements are coloured according to penetration depth. The penetrating nodes are shown by coloured crosses, with coloured arrows showing the “escape vector” – where the node would have to move to, in order to eliminate the penetration.

# Penetration checking

The pairs of parts that interact (penetrations or crossed edges) are shown. To display just one of those pairs or parts, click on it in the menu. Restore display of all parts using "Sel All".



PEN CHECK M1/CONT2

Dismiss Check all Options...

List Errors Check visible

All segments of contact checked

2 AUTOMATIC\_SINGLE\_SURFACE  
<No title defined>

select parts sel none sel all sel xedge ?

P8231:P8710 (5 x-edges 6 pens)

P8710:P82151 (0 x-edges 108 pens)

P8712:P82151 (0 x-edges 76 pens)

penetrations magnitude  $\geq$  0.0

sketch unblank recursive

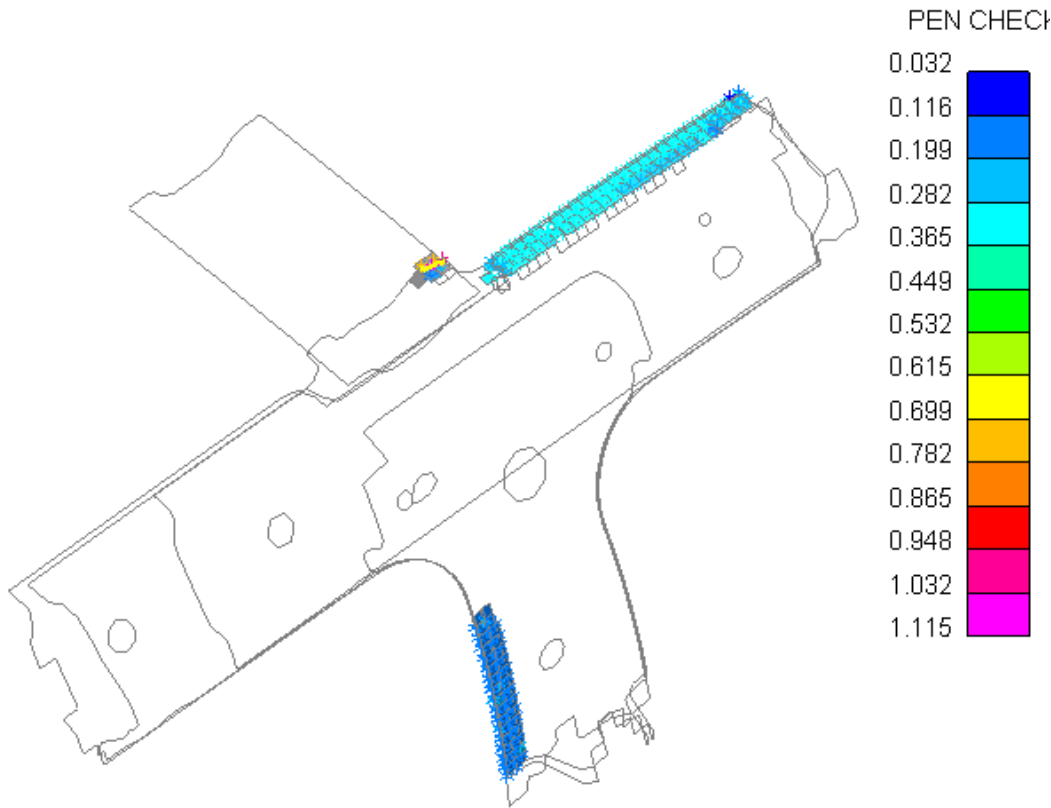
contour penetrating Pen: 6 vis 190 total  
X'ed: 5 vis 5 total  
Min: 3.2391e-002  
Max: 1.1148e+000  
Sum: 4.9069e+001

CT SI WIRE Settings... Levels... FIX

->warnings.k Element detail Beams on x-edge



# Contact penetrations - Settings



Call up the Settings panel

PEN CHECK M1/CONT2

Dismiss Check all Options...

List Errors Check visible

All segments of contact checked

2 AUTOMATIC\_SINGLE\_SURFACE

<No title defined>

select parts sel none sel all sel xedge ?

P8231:P8710 (5 x-edges 6 pens)

P8710:P82151 (0 x-edges 108 pens)

P8712:P82151 (0 x-edges 76 pens)

penetrations magnitude >= 0.0

sketch unblank recursive

contour penetrating Pen: 190 vis 190 total

CT SI WIRE X'ed: 5 vis 5 total

Settings... Min: 3.2391e-002

Levels... Max: 1.1148e+000

FIX Sum: 4.9069e+001

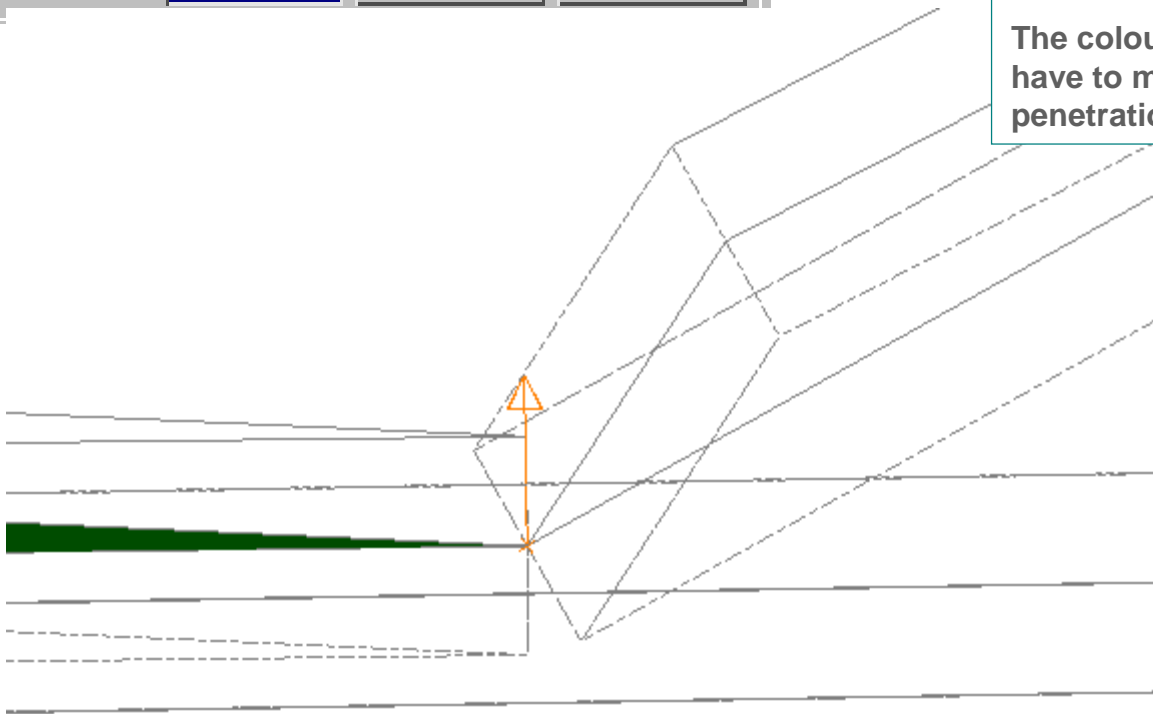
->warnings.k Element detail Beams on x-edge

# Contact penetrations - Settings

Penetration vectors	<input checked="" type="checkbox"/> DRAWN	<input type="checkbox"/> LABELS	<input type="checkbox"/> AS_THICK
Pen elems:	<input checked="" type="checkbox"/> DRAWN	<input type="checkbox"/> LABELS	<input checked="" type="checkbox"/> AS_THICK
Pen nodes:	<input checked="" type="checkbox"/> DRAWN	<input type="checkbox"/> LABELS	<input type="checkbox"/> DISTANCE

In the Settings panel, the different displays (penetrated elements, penetrating nodes, crossed edges) may be turned on or off, or labelled. Drawing the elements with their Contact Thickness can sometimes help to visualise why there is a penetration.

The coloured arrows show where the node would have to move to, in order to eliminate the penetration.

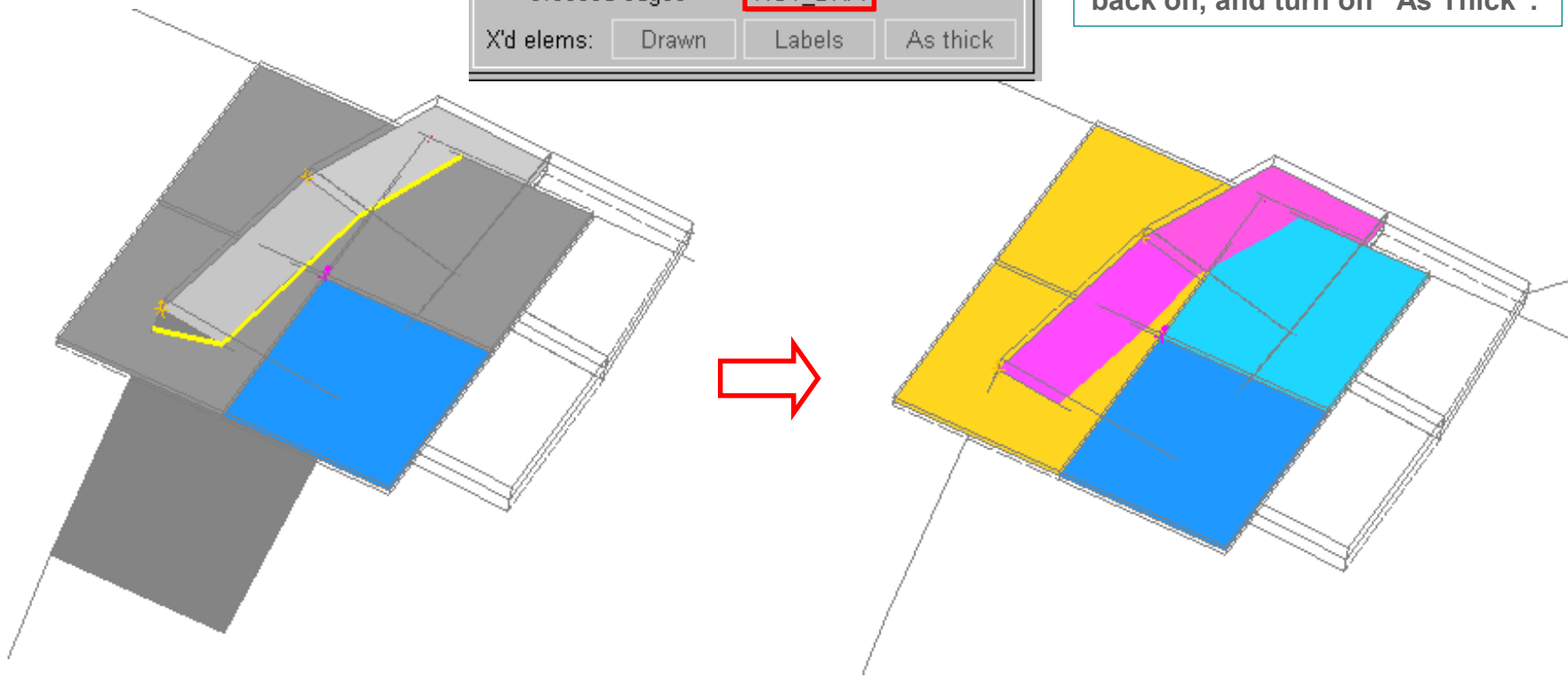


# Contact penetrations - Settings

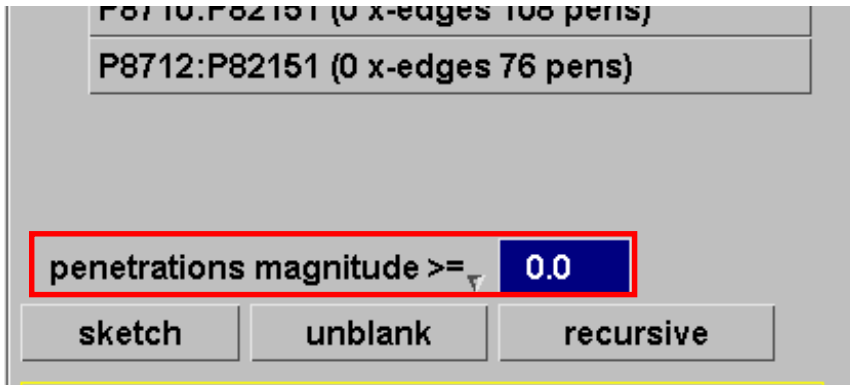
Penetration vectors	DRAWN		
Pen elems:	Drawn	Labels	As thick
Pen nodes:	Drawn	Labels	Distance
Crossed edges	NOT_DRA		
X'd elems:	Drawn	Labels	As thick

Try turning off Crossed edges, press UPDATE.

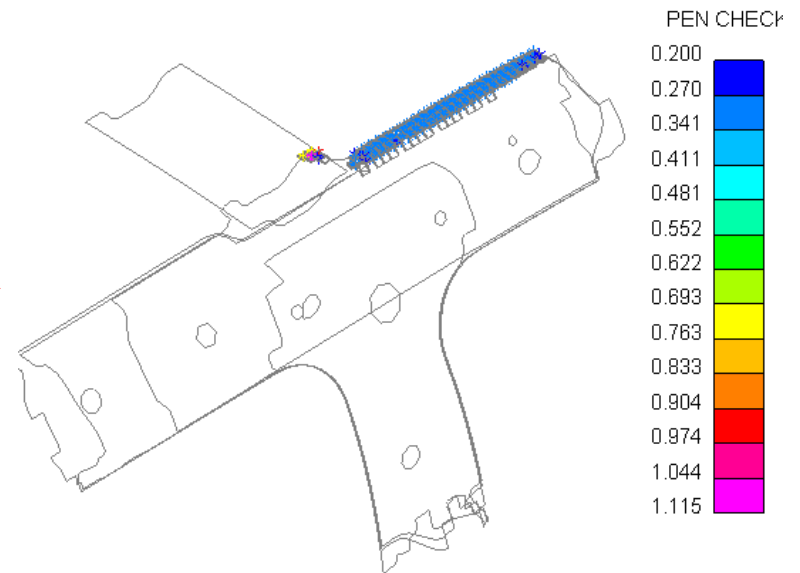
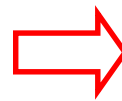
Before proceeding to the next step, turn the crossed edges back on, and turn off "As Thick".



# Contact penetrations - Settings

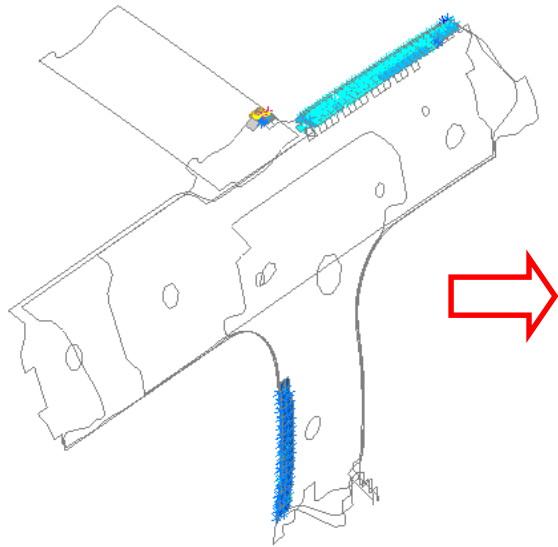


The LS-DYNA control flag IGNORE is recommended – this makes the contact algorithm tolerant to small penetrations. To find out whether any penetrations exceed a certain tolerance – say 0.2mm – input a minimum value in the Pen Check Panel. Update Plot. PRIMER now displays only penetrations greater than 0.2mm



# Contact penetration ratio

To find out whether any penetrations exceed, say, 0.2 times the shell thickness, set the data component to “ratio thickness remaining”, and the value to 0.8 (i.e. PRIMER will display colours only where the remaining thickness, after the penetration is subtracted, is 0.8 or less times the thickness).



PEN CHECK M1/CONT2

Dismiss Check all Options...  
List Errors Check visible

All segments of contact checked

2 AUTOMATIC\_SINGLE\_SURFACE  
<No title defined>

select parts sel none sel all sel xedge ?

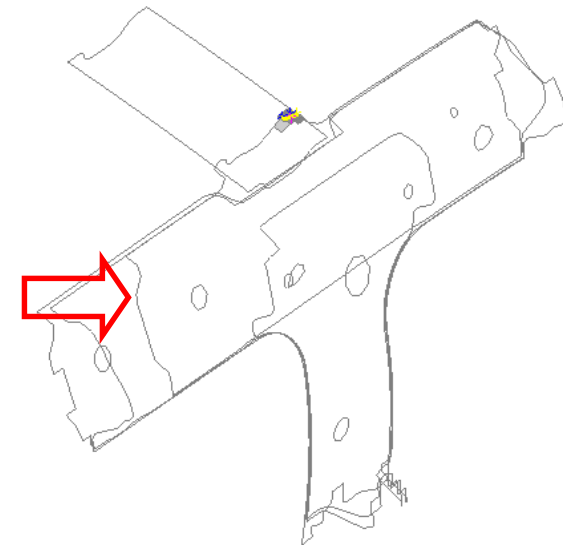
P8231:P8710 (0 x-edges 4 pens)

ratio thickness rem <= 0.8

sketch unblank recursive

contour penetrating Pen: 4 vis 4 total  
No crossed edges

CT SI WIRE



# Crossed edges - Fixing

PEN CHECK M1/CONT2

Dismiss Check all Options...

List Errors Check visible

All segments of contact checked

2 AUTOMATIC\_SINGLE\_SURFACE  
<No title defined>

select parts sel none sel all sel xedge ?

P8231:P8710 (5 x-edges 5 pens)  
P8710:P82151 (0 x-edges 105 pens)

penetrations magnitude >= 0.2

sketch unblank recursive

contour penetrating Pen: 110 vis 110 total  
X'ed: 5 vis 5 total  
Min: 2.2175e-001  
Max: 1.1148e+000  
Sum: 3.4155e+001

CT SI WIRE Settings...

FIX

->warnings.k Element detail Beams on x-edge

PEN CHECK M1/CONT2

Dismiss Check all Options...

List Errors Check visible

Select nodes to move

Crossed Penetrating End fix

Apply fix Undo last Undo all

P8231:P8710 (5 crossed elements)

CT SI WIRE Settings...

Auto fix  
 N1 -> N2  
 Normal to shell  
 Normal to N1N2N3  
 Along vector

ADD nodes to fix REM nodes from fix

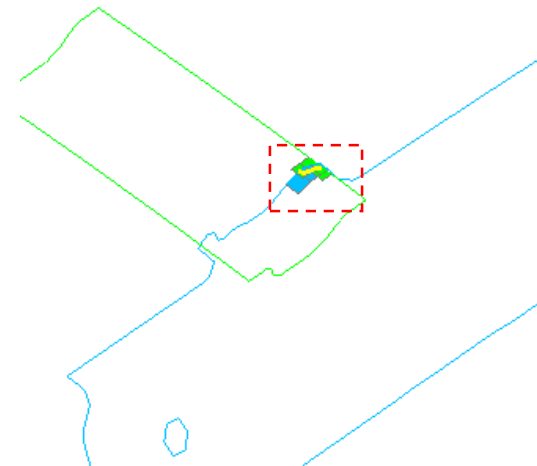
sketch selected nodes clear node selection

penetrating nodes

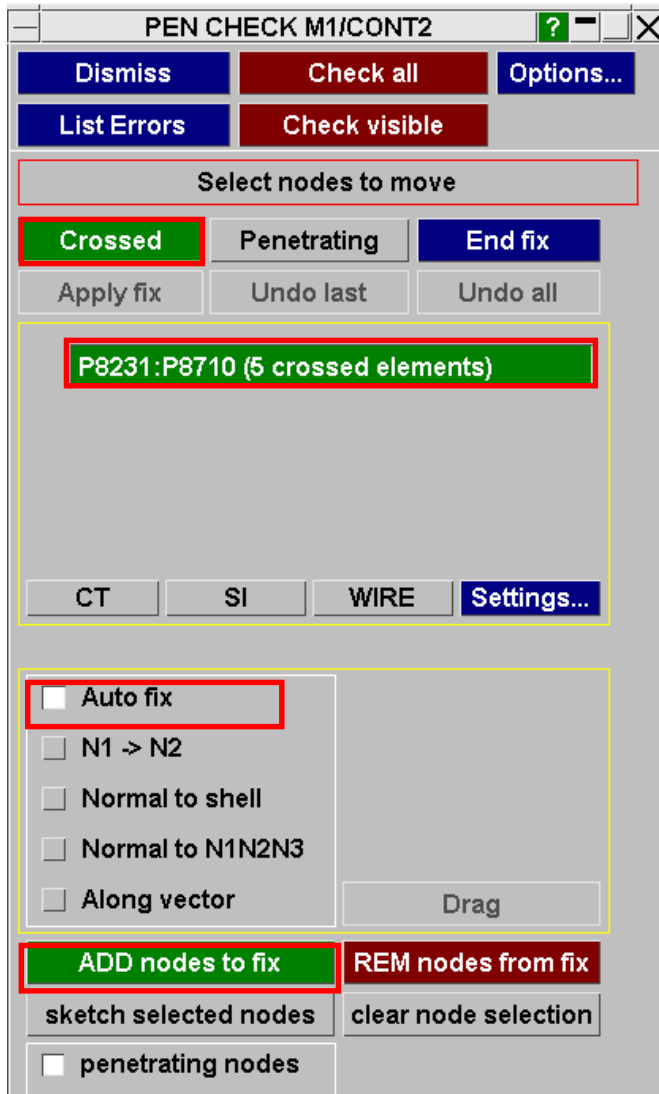
Press FIX. We recommend to fix the crossed edges first.

PRIMER offers the pairs of parts that are intersecting. Click on the only pair. PRIMER shows just these parts.

Zoom in on the affected region.

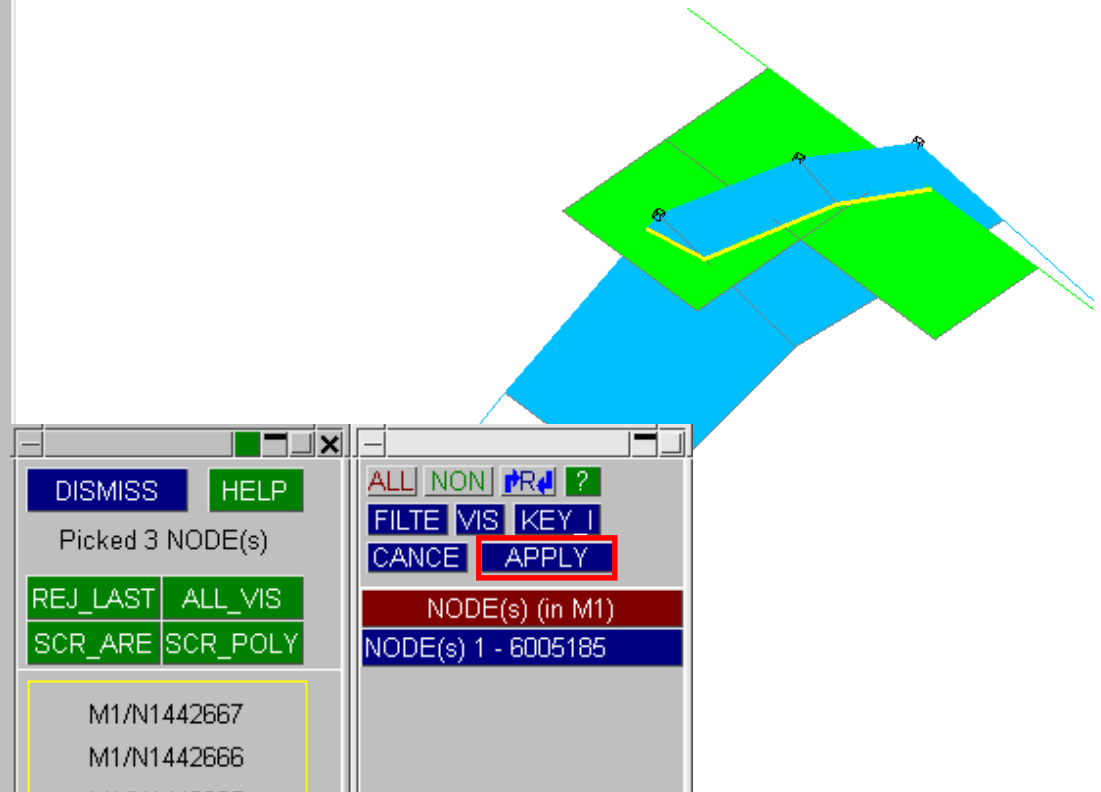


# Crossed edges - Fixing



We must tell PRIMER which nodes are on the “wrong” side. Use “ADD nodes to fix” to select the three nodes shown, APPLY to confirm the node selection.

There is a choice of manual (e.g. dragging) or automatic methods to calculate the movement of each node.



# Penetrations – Manual Fixing

The screenshot shows the 'PEN CHECK M1/CONT2' window. At the top, there are buttons for 'Dismiss', 'Check all', 'Options...', 'List Errors', and 'Check visible'. Below this, a status bar indicates '1 nodes selected to fix'. The 'Penetrating' mode is selected, with 'Apply fix', 'Undo last', and 'Undo all' buttons. A table shows the status of the fix:

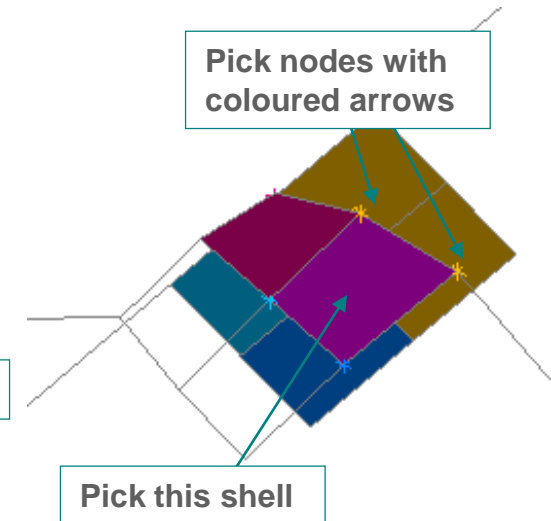
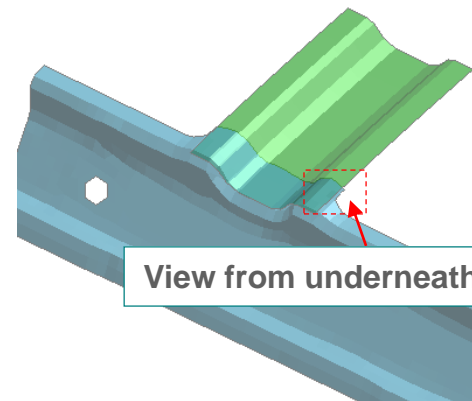
CT	SI	#cross	Initial	Iter 0
			0	0
		#pen	5	5
		Max	1.11e+00	1.11e+00
		Min	2.22e-001	2.22e-001
		Sum	3.42e+00	3.42e+00

Below the table, it says 'ignoring pens < 2.390753E-2'. The 'Manual' mode is selected, with 'Shell: 9019' and 'Dist: 1.0' set. The 'Normal to shell' checkbox is checked. At the bottom, there are buttons for 'ADD nodes to fix', 'REM nodes from fix', 'sketch selected nodes', and 'clear node selection'.

Switch to Penetrating, ensure the menu is switched to Manual, press SI.

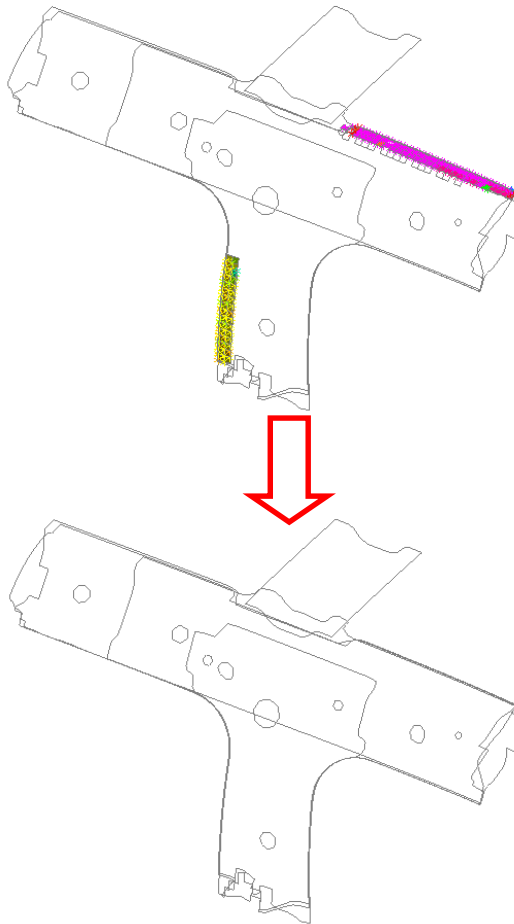
Although we have fixed the crossed edges, the same two parts are still penetrating. We will now fix these penetrations manually.

Use “ADD nodes to fix” to select the nodes to be dragged. Try dragging using “normal to shell”, until these penetrations disappear.





# Penetrations – Automatic Fixing



Dismiss Run Checker

List Errors Check Defn

Iteration 4/10

Crossed Penetrating End fix

Apply fix Undo last Undo

Status		Initial	Iter
CT	SI	Num crossed	0
WIRE		Num penetrati	198
Setting		Max pen	2.9928e-001 0.0000
Level		Min pen	3.2398e-002 0.0000
		Sum pens	4.8006e+001 0.0000

Characteristic length = 9.652691 (pens < 4.826)

Automatic fixing Manual fixing

Show Sketch Select

Show Sketch Select

- 8231: BOW\_ROOF\_C18
- 8700: PANEL\_BSO\_RT
- 8710: REINF\_A\_PILLAR\_INR\_LWR\_RT
- 8712: REINF\_B\_PILLAR\_RT
- 82151: Default PSHELL Property

Allow worse pens % to move each iter 50

Number of iterations 10

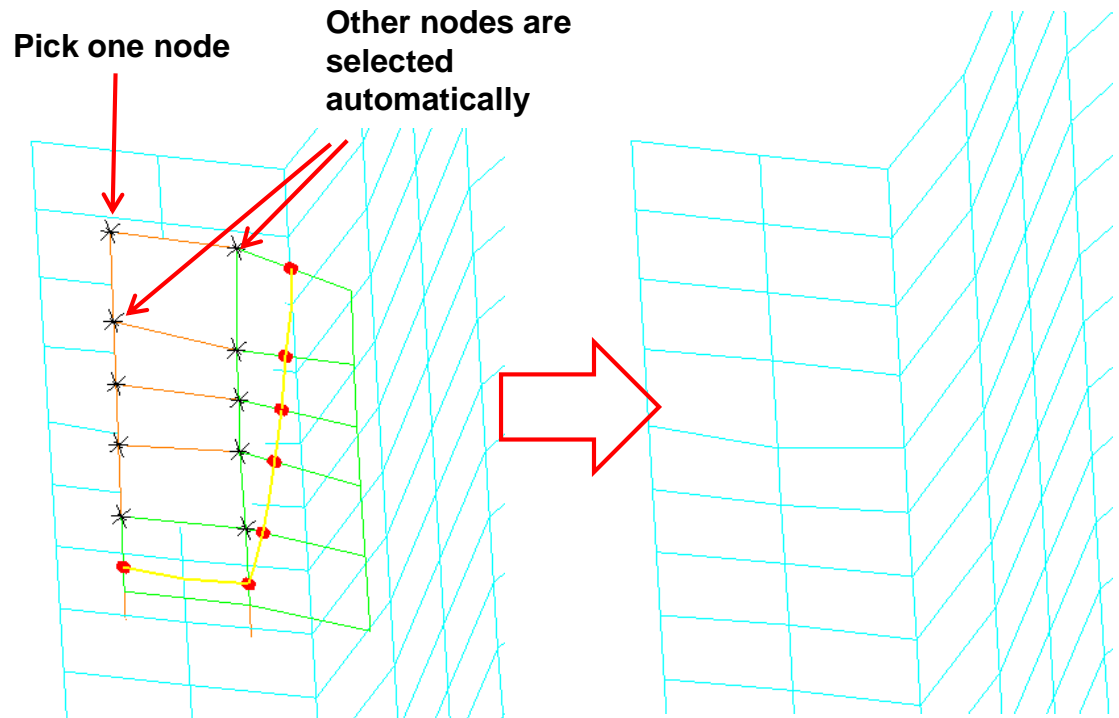
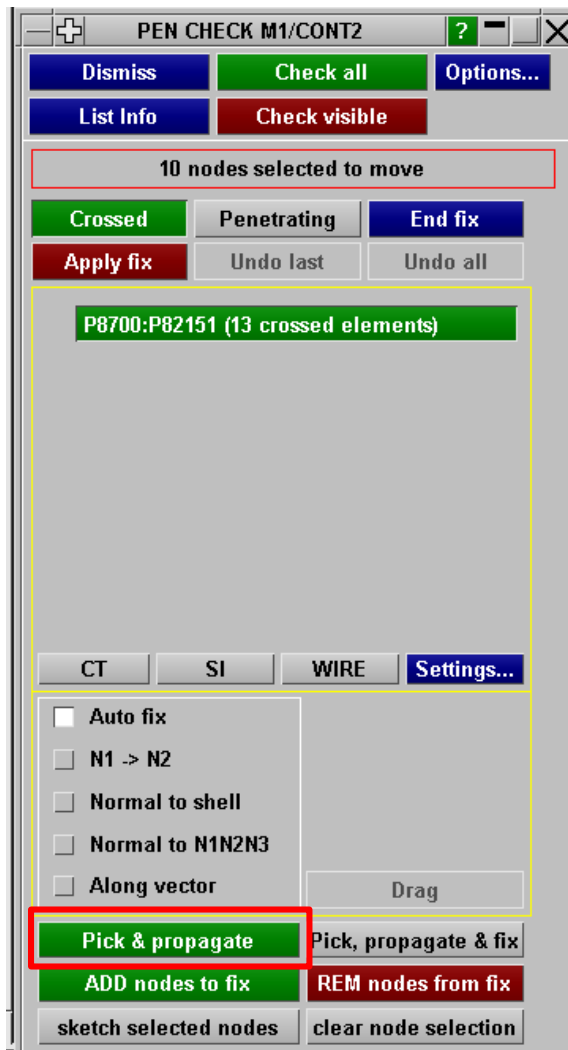
Unblank the whole model (shortcut U). We will fix the remaining penetrations using the Automatic method.

Switch to Automatic Fixing. Press Apply.

PRIMER moves the penetrating nodes iteratively to reduce the penetrations. In this model, all the penetrations are fixed.

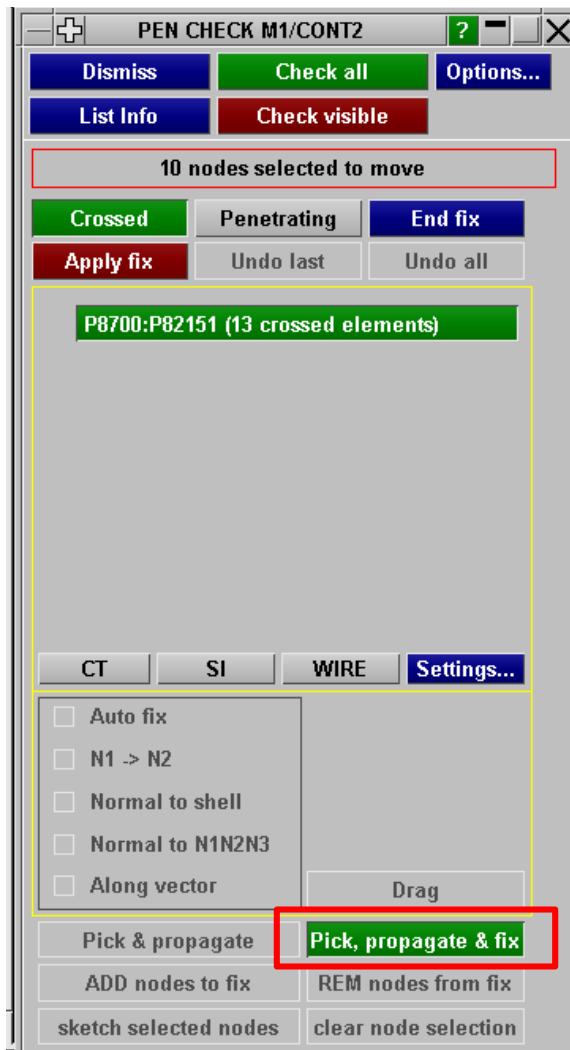
In more complex models, some penetrations may remain; these need to be fixed manually. Usually the reasons are either (a) crossed edges have not been fixed or (b) since PRIMER moves only the penetrating nodes (shown with coloured arrows), not the penetrated elements, this is not always enough to resolve complex multi-layer situations.

# Penetrations: Crossed Edge Fixing

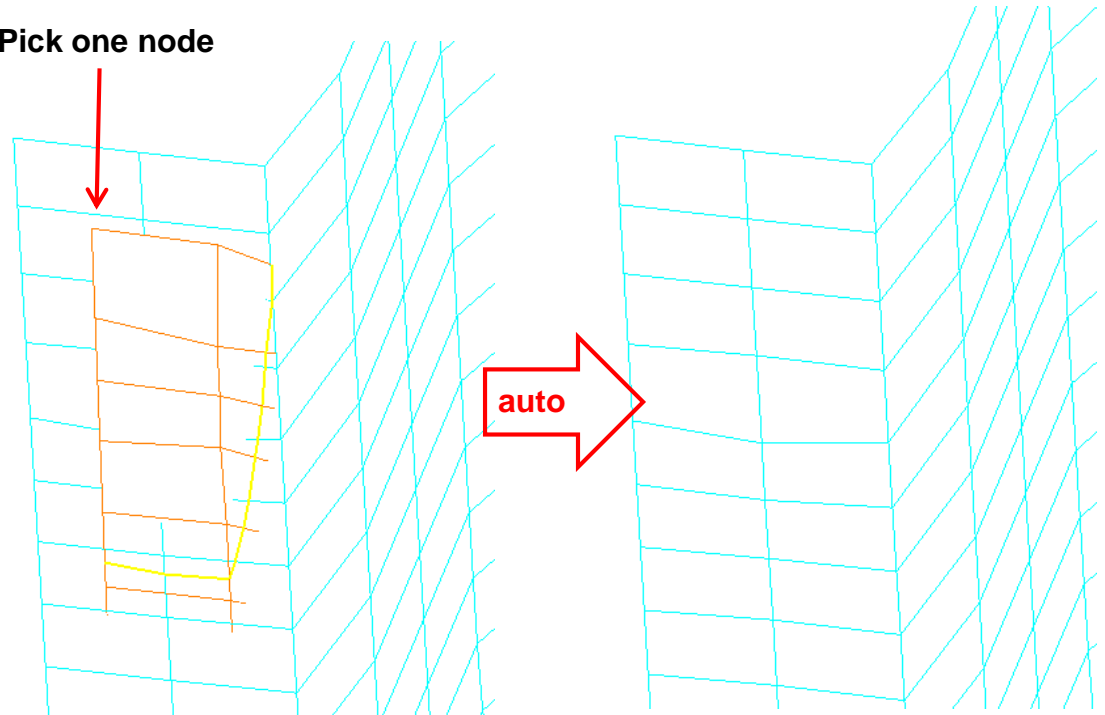


**“Pick & propagate”** allows user to pick one node; PRIMER then automatically selects all the other nodes that are on the same side of the Crossed Edge. Selection can be adjusted using ADD, REM  
Fixing the selected nodes is a separate operation. The usual methods are available, e.g. “Auto fix”, “Normal to shell”, etc

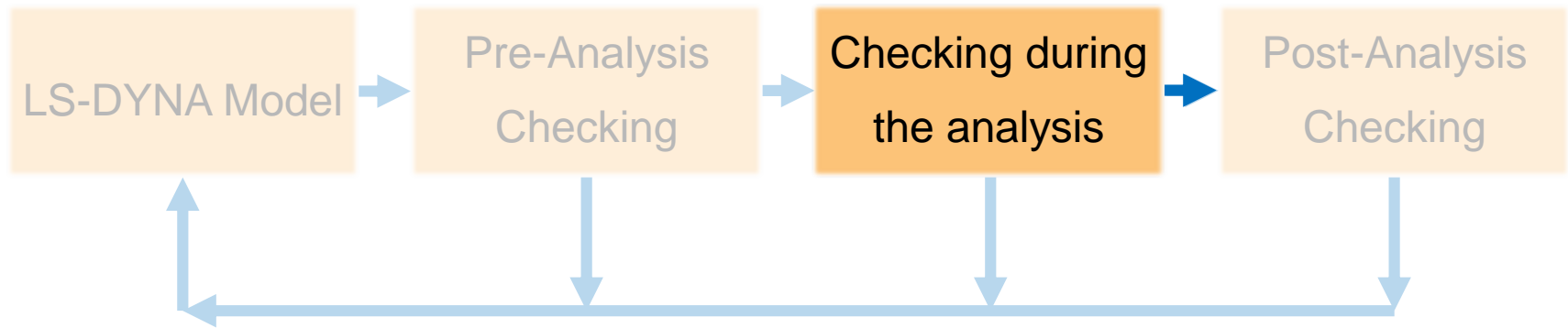
# Penetrations: Crossed Edge Fixing



Pick one node

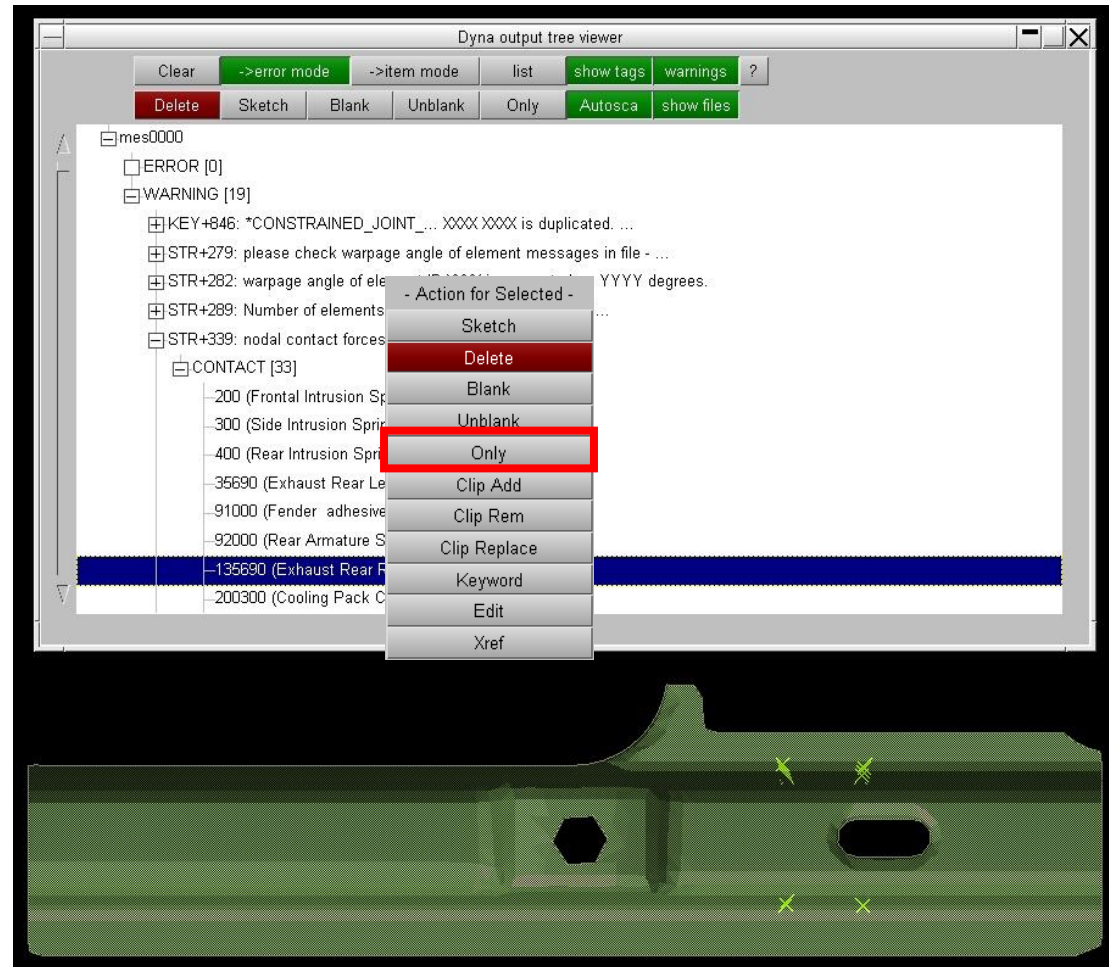
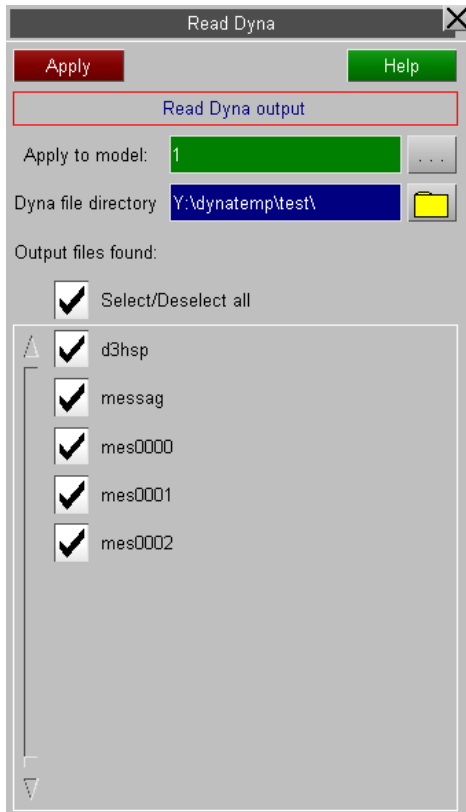


“Pick, propagate & fix” allows user to pick one node; the selection of other nodes that are on the same side of the Crossed Edge, and the fixing, are both performed automatically in a single operation



# Reading LS-DYNA Output Text Files

# LS-DYNA Output file reader



LS-Dyna output files from the selected directory can be interrogated for errors, warnings or other data. If the associated model is loaded, entities to which the output message refers can be manipulated.

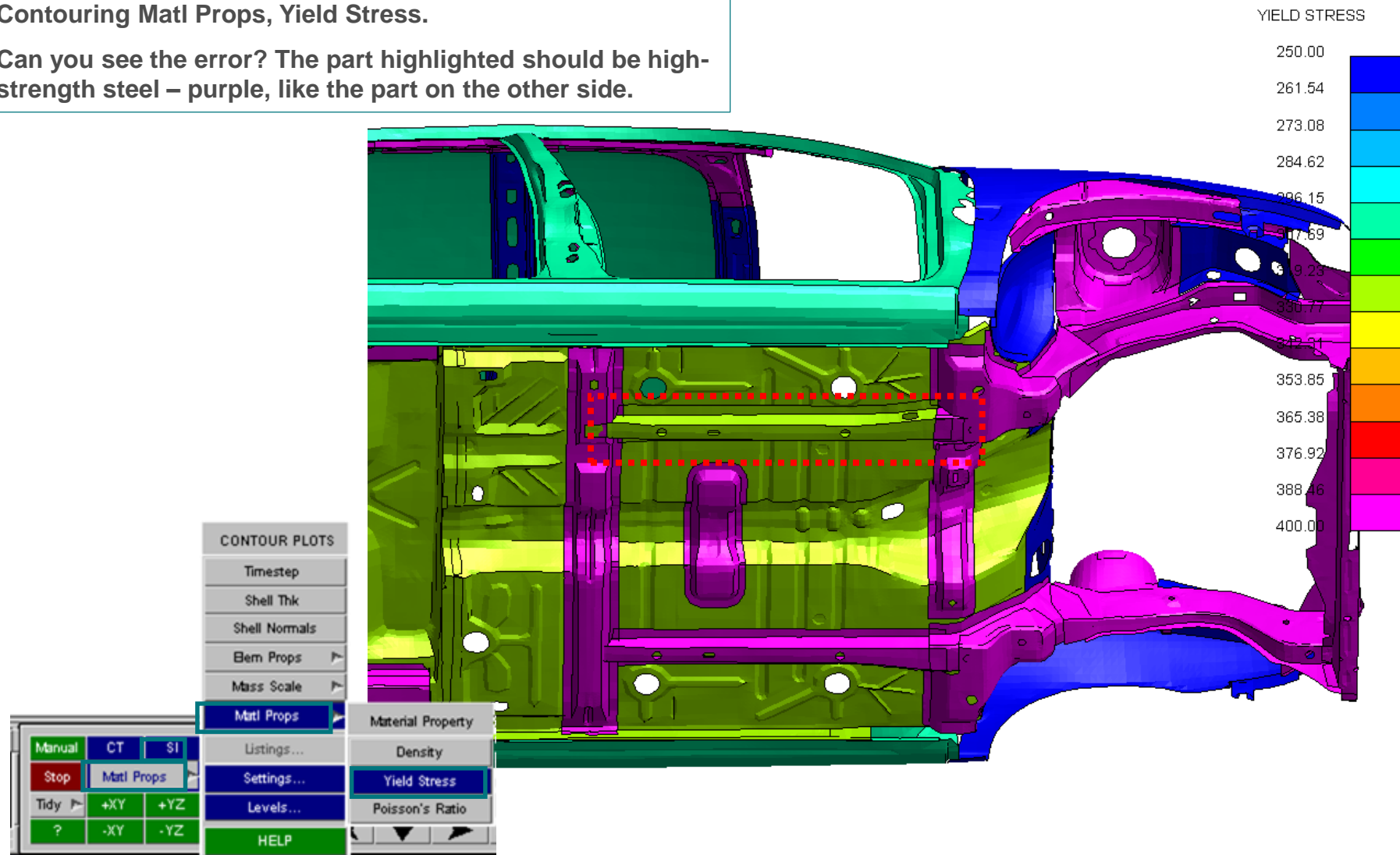
# Visual Checking Features

# Contouring



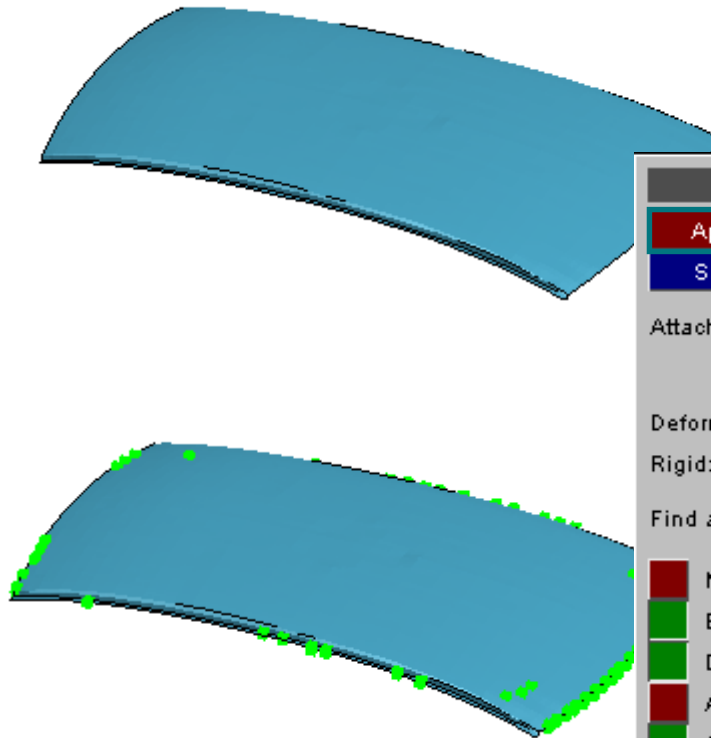
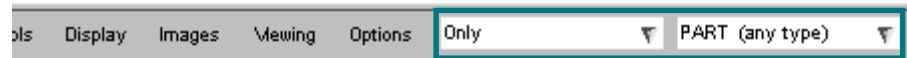
# Visual Checking - Contouring

Contouring Matl Props, Yield Stress.  
Can you see the error? The part highlighted should be high-strength steel – purple, like the part on the other side.



**Attached**

# Visual checking – Find Attached

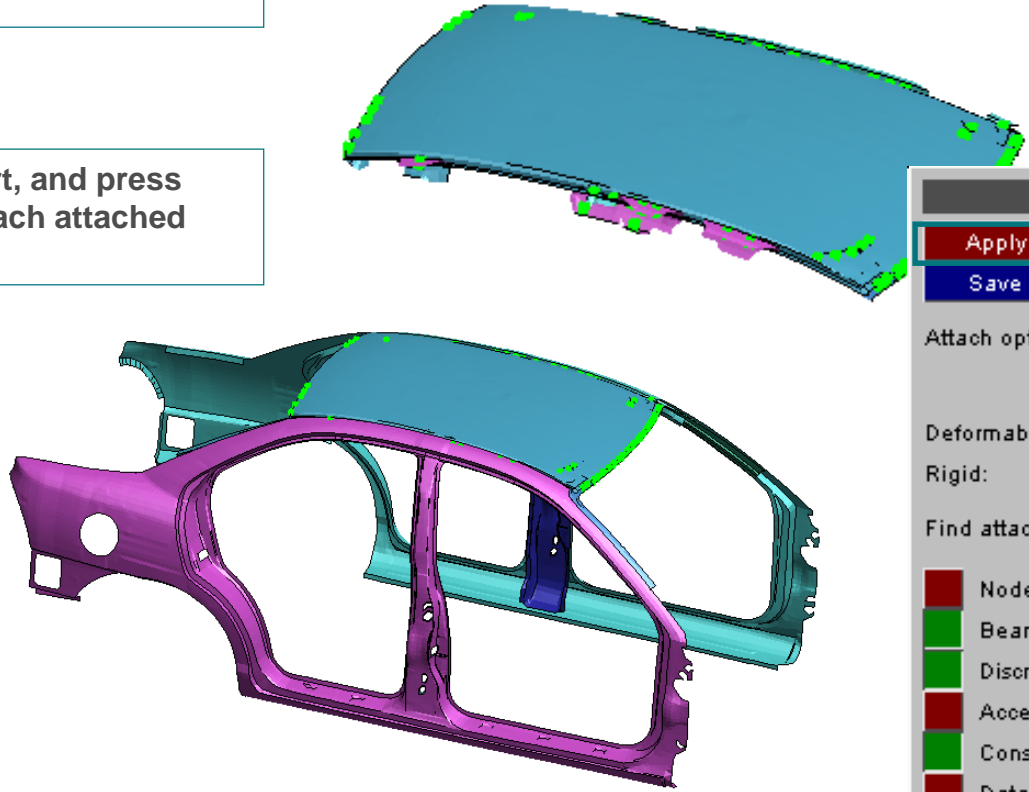


Under Tools, press **ATTACHED**. In the attached menu, press **APPLY**. PRIMER finds and displays any entities joined to the entities already displayed – in this case, mesh-independent spotwelds that are joined by a tied contact. PRIMER uses the same thickness tolerances etc as LS-DYNA to decide which nodes are tied by a tied contact.

# Visual checking – Find Attached

Press **APPLY** a few more times.  
Elements of the panels attached to the spotwelds appear.

Now click **Attached Part**, and press **APPLY**.  
The whole of each attached part appears.



**Attached** [X]

**Apply** **Blank** **Entities** **Help**

**Save current** **Restore saved**

Attach opts: **Beam 3rd nodes** **Beam PID's**  
**Tied contacts** **Recursive**

Deformable: **Attached part** **Single elems**

Rigid: **Whole part** **Single elems**

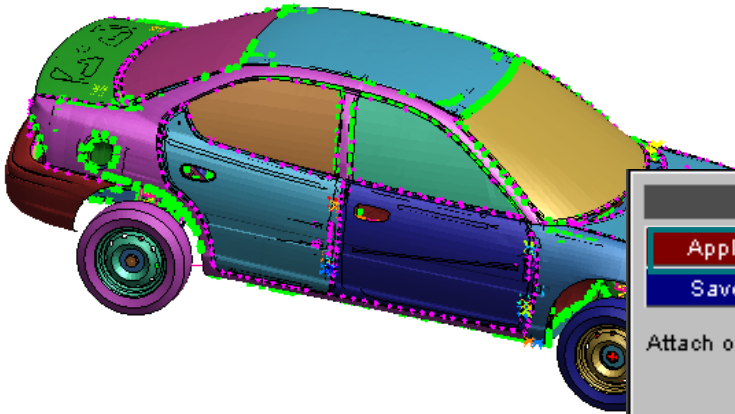
Find attached through: **(All off)** **(All on)**

<input type="checkbox"/> Node	<input type="checkbox"/> Solid
<input type="checkbox"/> Beam	<input type="checkbox"/> Shell
<input type="checkbox"/> Discrete	<input type="checkbox"/> Mass
<input type="checkbox"/> Accelerometer	<input type="checkbox"/> Airbag
<input type="checkbox"/> Constrained	<input type="checkbox"/> Contact
<input type="checkbox"/> Database	<input type="checkbox"/> Define
<input type="checkbox"/> Set	

# Visual checking – Find Attached



To find every connected entity (without pressing APPLY many times), click Recursive. Press APPLY. PRIMER automatically continues to find attached entities until no more are found.



Finally, press R to reverse the blanking. Any loose part will now be displayed. These need to be fixed to the car.



Attached												
Apply	Blank	Entities	Help									
Save current		Restore saved										
Attach opts:	Beam 3rd nodes	Beam PID's										
	Tied contacts	Recursive										
Deformable:	Attached part	Single elems										
Rigid:	Whole part	Single elems										
Find attached through: (All off) (All on)												
Node	Beam	Discrete	Accelerometer	Constrained	Database	Set	Solid	Shell	Mass	Airbag	Contact	Define

# Exploded View

# Exploded view

Selected entities of a specific type can be pushed away from other entities of that type while being treated as choate blocks. Supported entity types are: includes, parts, part sets and part tree assemblies

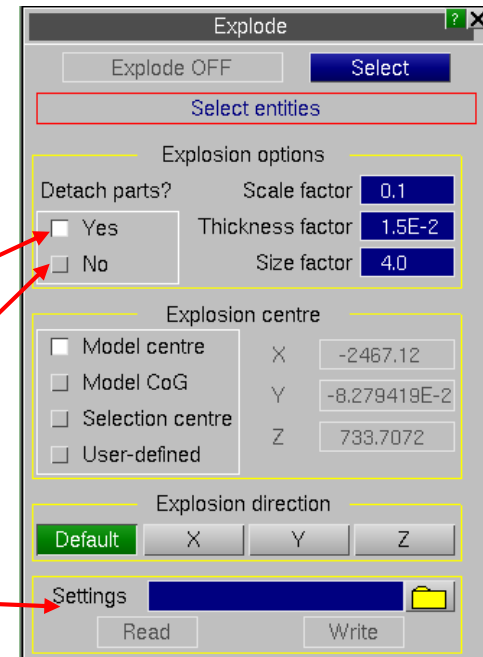


Two modes - part-based and node-based - are available:

1. Part-based explosion will cause parts that are meshed together to move apart while ignoring shared nodes
2. Node-based explosion may cause parts that are meshed together to deform to account for the shared nodes

Options to control explosion centre, direction, step size, padding around entities and overall scree space are available

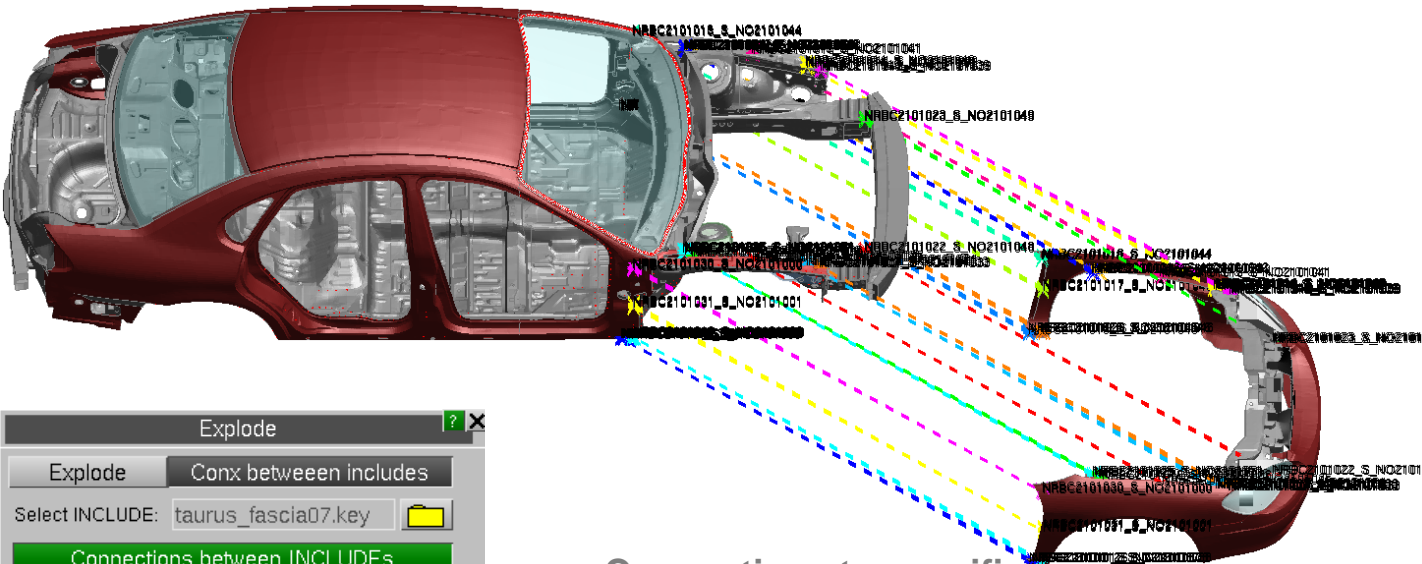
Explosion offsets may be saved for subsequent retrieval



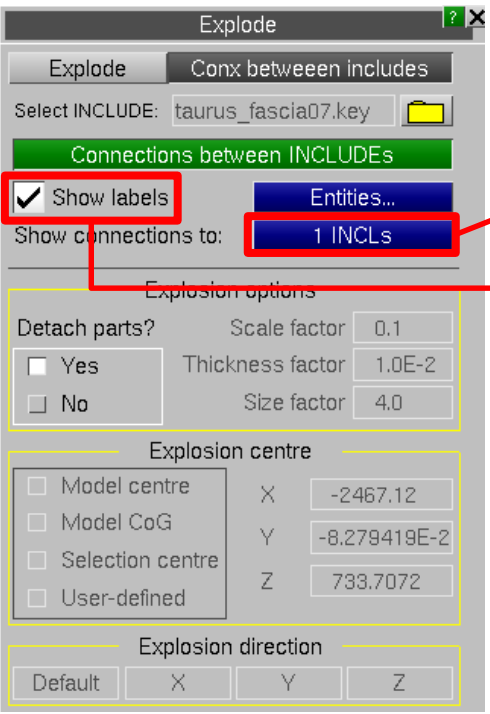
# Connections between includes



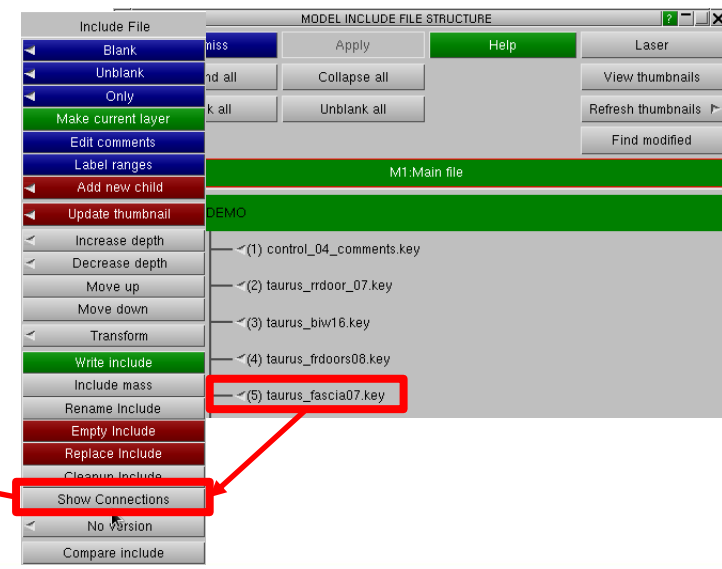
# Connections between includes



- Connections between selected include and others in the model can be viewed in the Explode menu
- Relevant includes are exploded away from others and unconnected includes hidden



- Connections to specific includes can be viewed
- Connection labels can be shown/hidden
- “Connections” include constrained items, elements and tied contacts
- Accessible from the Include tree

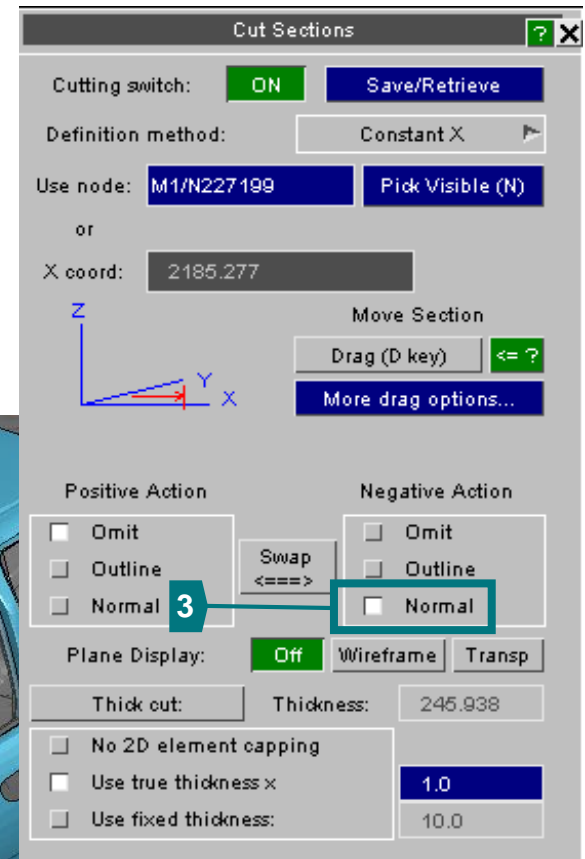


# Cut Section

# Cut section

## Cut Section

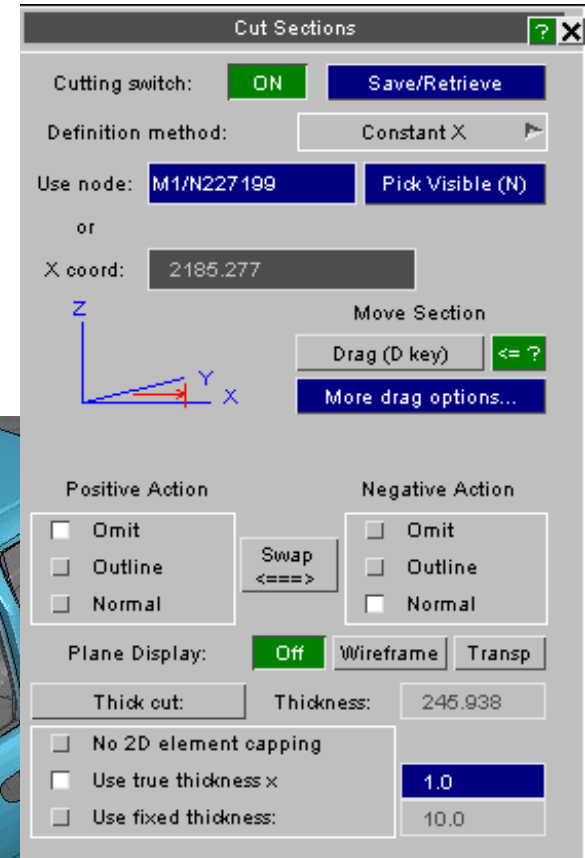
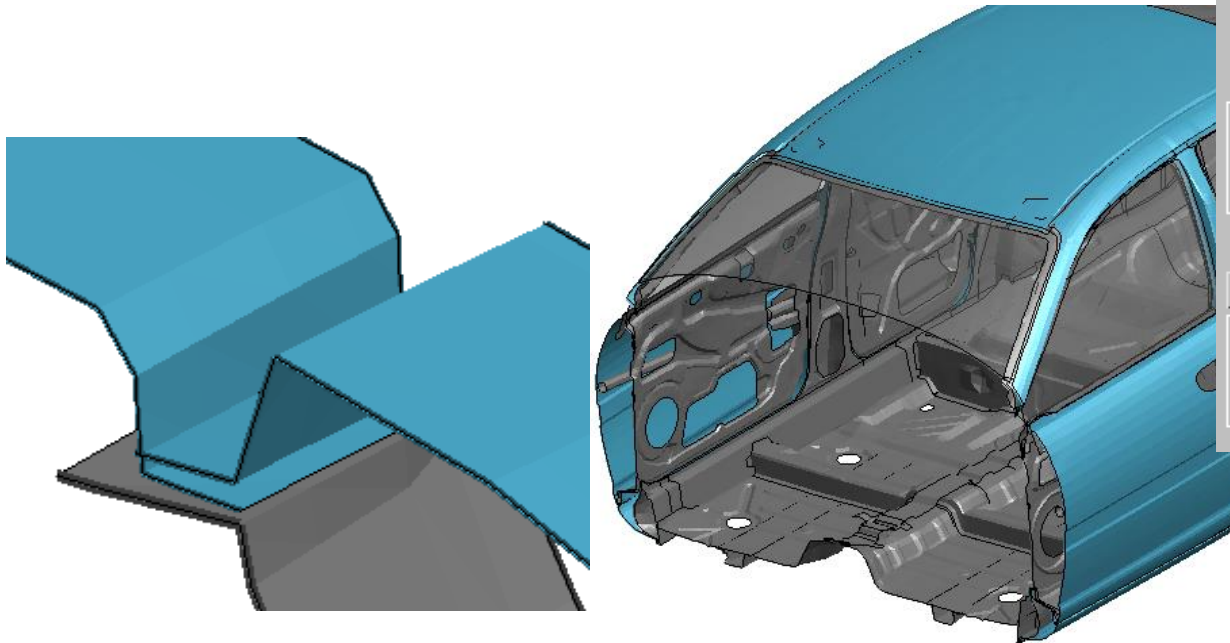
1. Shortcut **X** to bring up the cut-section menu.
2. Shortcut **N** to activate node-picking, then click near the centre of the roof. Display changes to a cut-section at constant X through the picked node.
3. In the menu, change Negative Action to **Normal** (i.e elements behind the plane are drawn normally).



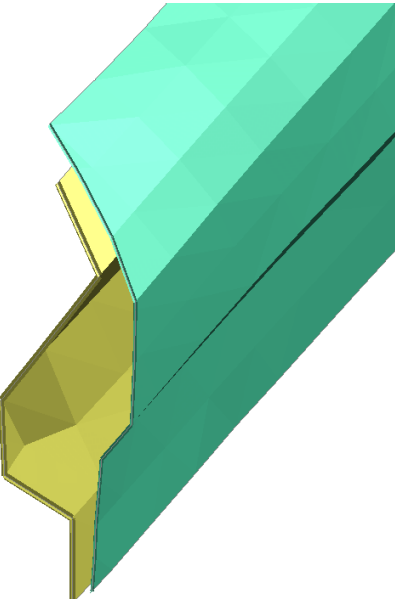
# Cut section

## Cut Section

1. Zoom in on the cantrail. The cut edges of shells are drawn with their actual thickness – useful for seeing whether there are gaps (as in this model) or interferences.
2. Shortcut **D**, drag the section through the model.



# Cut section - properties



**Cut Sections**

Cutting switch: **ON** Save/Retrieve

Definition method: Constant X

Use node  Pick Visible (N)

or

X coord: 2844.23

Move Section  
 Drag (D key) <= ?  
 More drag options...  
 Properties...

Positive Action Negative Action

Omit  Omit  
 Outline  Outline  
 Normal  Normal

Plane Display: **Off** Wireframe Transp

Thick cut ?  Multiple cuts ?  
 Thickness: 245.4811 Spacing: 490.9622  
 +/- Np: 999 999

No 2D element capping Explain  
 Use true thickness x 1.0  
 Use fixed thickness: 10.0  
 Use Part\_Contact values:

**CUTSECT PROPS in model 1**

Dismiss Export to C Export to BMP Export geo  
 Recompute Autoscale Cursor Zoom Options...

Ignore blanked elems  
 Include blanked elems

Section origin: 2844.23 56.85827 1156.074  
 X axis vector: 0.0 1.0 0.0  
 Y axis vector: 0.0 0.0 1.0  
 Z axis vector: 1.0 0.0 0.0

500.0 525.0 550.0 575.0 600.0

100.0 75.0 50.0 25.0

lxx lyy luu lvv

(Xc,Yc) 22.2249 deg

500.0 525.0 550.0 575.0 600.0

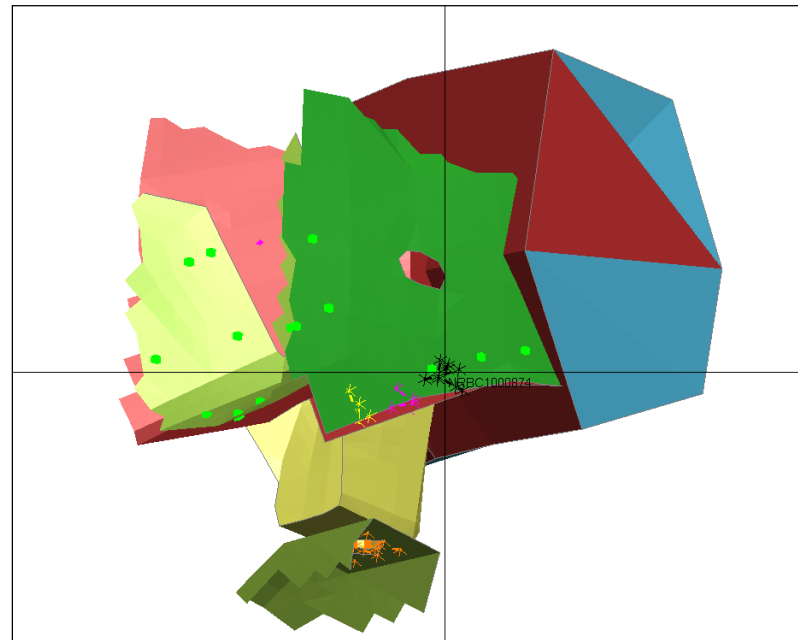
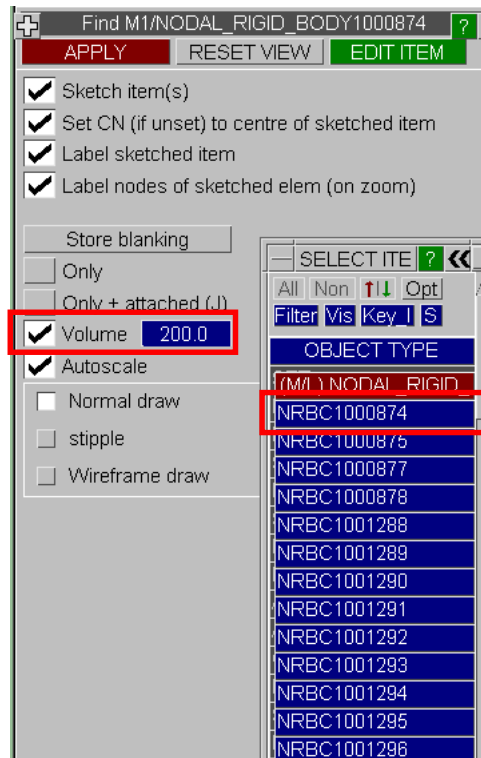
25.0 50.0 75.0 100.0

Elastic Properties			Plastic Properties		Forces and Moments			
<input checked="" type="checkbox"/> Show on plot ?			<input type="checkbox"/> Show on plot ?			First yield ?		
Area	Xc	Yc	Eq Area axes	Xe	Ye	Axial	Mxx	Myy
276.4609	559.7606	55.86439		555.2786	54.67168	110584.4	1507454.	685731.6
lxx	lyy	lxy	Plastic Moduli	Zxx	Zyy	Fully plastic ?		
165761.1	50904.92	-56335.5		6042.172	3223.36	Eq Force axes Xf Yf		
luu	lvv	Theta	<b>Calculate Torsion properties...</b>				555.2786	54.67168
188779.8	27886.24	22.2249				Axial	Mxx	Myy
						110584.4	2416869.	1289344.

# Find

# Find

- The “Find” function can be used to easily find entities in the model, and see their surroundings.

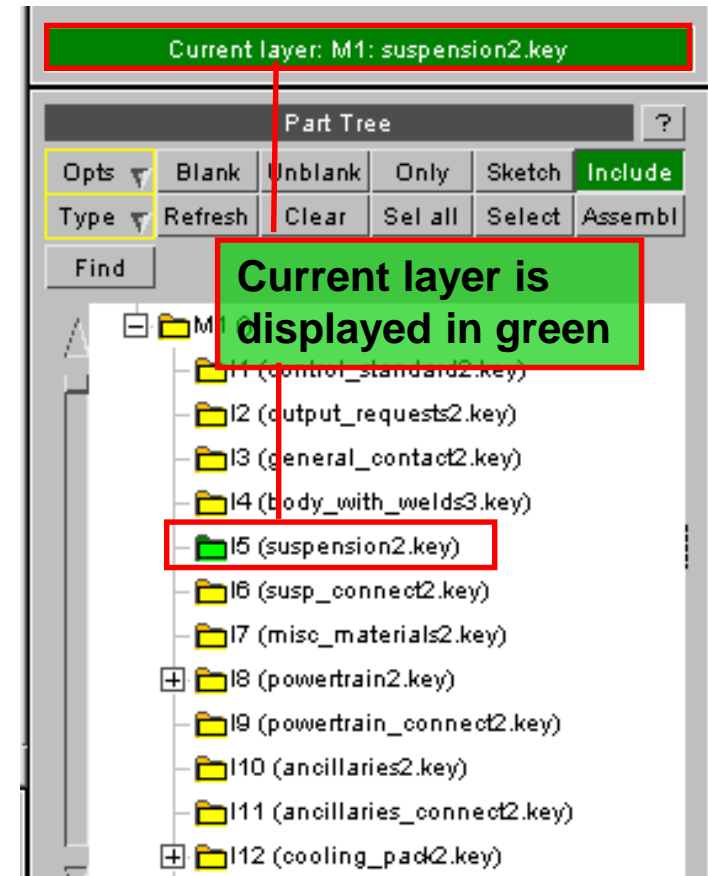
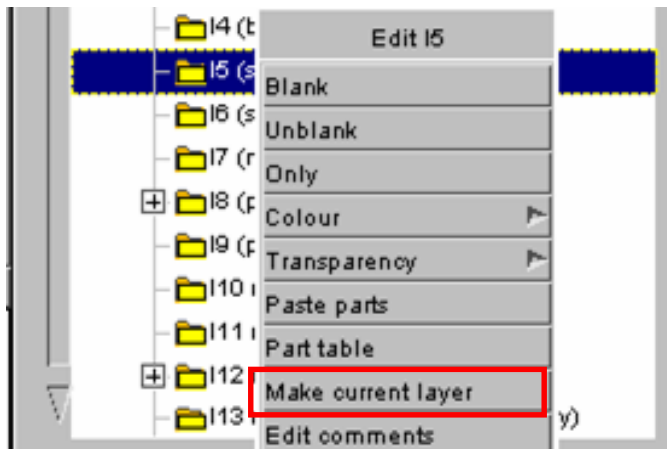


# Checking Include Files



# INCLUDE file for newly created entities

- If the user copies or modifies data, the modified or new data is put into the same INCLUDE file as the original data.
- When the user creates new data, how does PRIMER decide into which INCLUDE file it should be put?
- Answer: the “Current Layer” means the INCLUDE file for newly created data.
- To set the current layer, right-click on Include file in Part Tree, Make Current Layer.



# Numbering an INCLUDE file

- This allows you to specify ID ranges for each include file

Renumber include file ranges for model 1: demo\_car4.key

Apply Read csv Write csv Copy no/el/nset/nrb/cwld/hswa ranges to ge

Options Retain original order

File name	Range unique	In range?	General		no/el/nset/nrb/cwld/hswa		Auto all
			Start	End	Start	End	
demo_car4.key	INACTIVE	INACTIVE	0	0	0	0	Auto
control_standard2.	INACTIVE	INACTIVE	0	0	0	0	Auto
output_requests2.	INACTIVE	INACTIVE	0	0	0	0	Auto
general_contact3.k	INACTIVE	INACTIVE	0	0	0	0	Auto
body_with_welds4.	INACTIVE	INACTIVE	0	0	0	0	Auto
suspension2.key	INACTIVE	INACTIVE	0	0	0	0	Auto
susp_connect2.ke	INACTIVE	INACTIVE	0	0	0	0	Auto
misc_materials3.ke	INACTIVE	INACTIVE	0	0	0	0	Auto
powertrain2.key	INACTIVE	INACTIVE	0	0	0	0	Auto
powertrain_conne	INACTIVE	INACTIVE	0	0	0	0	Auto
ancillaries2.key	INACTIVE	INACTIVE	0	0	0	0	Auto

Model functions

Create	Copy	Renumber	Utilities
Read	Merge	Delete	List
Write	Build	Contents	Modified?

Apply Model/contents renumber

Model No: 1 (Neon model for Primer D) ...

Renumber contents	Change item labels
Change model id	Give new model No
Condense model ids	Reset all model Nos
Renumber selection	Change preselected labls
Set MID -> PID	Change material labels
MAT24 LCSS/LCSR	Unique lc/tbid for mat24
Condense mats	Reduce material cards
Set SID -> PID	Change section labels
<b>Renumber includes</b>	Renumber include ranges
Declash labels	Declash Elements/Sets/Mat



# Numbering an INCLUDE file

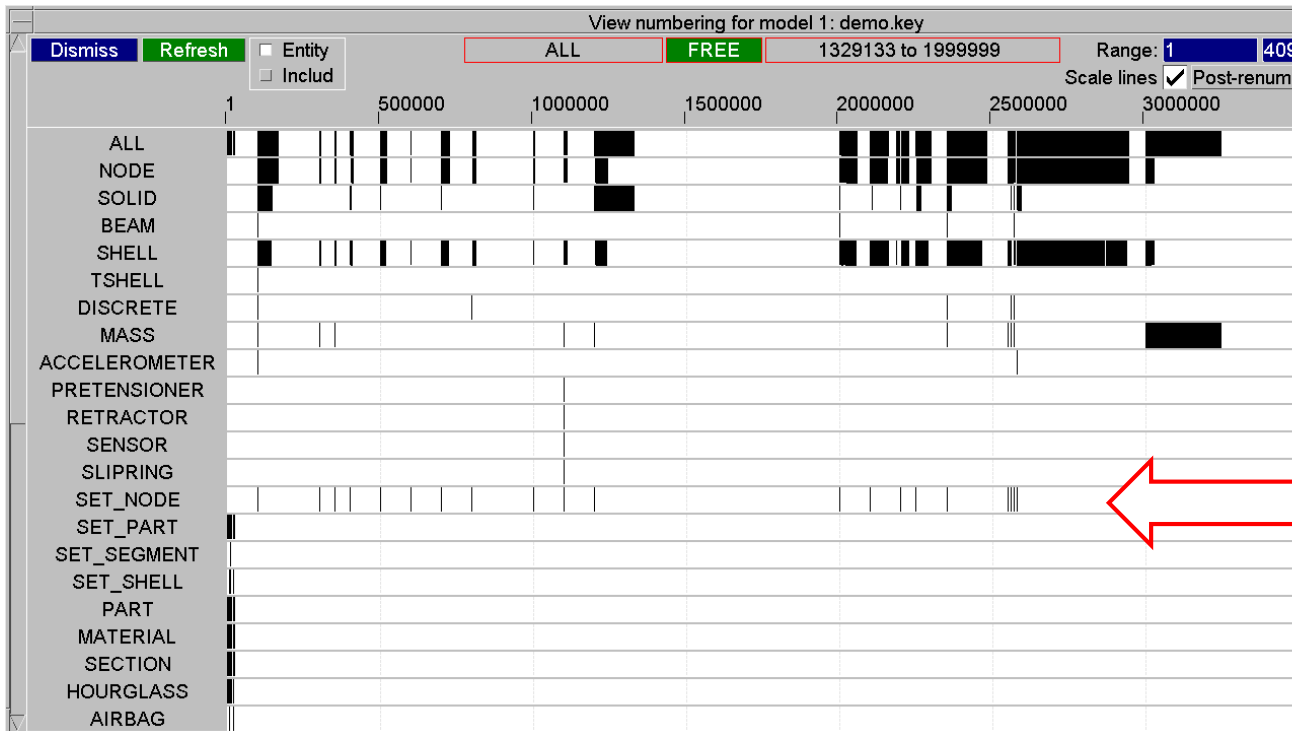
File name	Range unique	In range?	General		no/el/nset/nrb/cwld/hswa		Auto all
			Start	End	Start	End	
demo.key	INACTIVE	INACTIVE	0	0	0	0	Auto
control_04_comme	INACTIVE	INACTIVE	0	0	0	0	Auto
taurus_rrdoor_07.k	OK	YES	20000	20099	2000000	2000999	Auto
taurus_biw16.key	OK	NO	21000	21499	2581000	3080999	Auto
taurus_frdoors08.k	OK	YES	20100	20199	2001000	2100999	Auto
taurus_fascia07.ke	OK	YES	20200	20299	2101000	2200999	Auto
taurus_hood06.key	OK	YES	20300	20399	2201000	2250999	Auto
taurus_ancils09.ke	OK	YES	20400	20499	2251000	2350999	Auto
taurus_pwr11.key	OK	YES	20500	20699	2351000	2550999	Auto
seatD_09.key	OK	YES	12000	12999	1200000	1399999	Auto
belt_07.key	OK	YES	11000	11499	1100000	1149999	Auto

- Two ranges can be set for each include
  - One range for nodes/elements + some other types
  - One range for all other labelled entities.
  - Both ranges can be the same.
- Label ranges can be typed in, or imported from a CSV file.
- Label ranges are saved as comments to each include file.
- The panel will tell you if you have entities within an include file which is outside the specified range.
- Entities can be renumbered into range through this panel.
- Ranges are also used during creation of entities when assigning ID's.

# Visualising Labels

# Visualise Labels

- A graphical display shows which labels (ID's) are used, and which are free.



Create	Copy	Renumber	Utilities
Read	Merge	Delete	List
Write	Build	Contents	Modified?

Apply    Model/contents renumber

Model No: 1 (DEMO) ...

Renumber content	Change item labels
Change model id	Give new model No
Condense model i	Reset all model Nos
Renumber selectio	Change preselected la
Set MID -> PID	Change material labels
MAT24 LCSS/LCS	Unique lc/tbid for mat24
Condense mats	Reduce material cards
Set SID -> PID	Change section labels
Renumber includes	Renumber include rang
Declash labels	Declash Elements/Sets
<b>Visualise</b>	Visualise labels used
Label range	Permitted max labels

options for condense mats

<input type="checkbox"/> curve inspect O	<input type="checkbox"/> ignore matl title
<input type="checkbox"/> curve inspect O	<input type="checkbox"/> read matl title

options for MID->PID and SID->PID

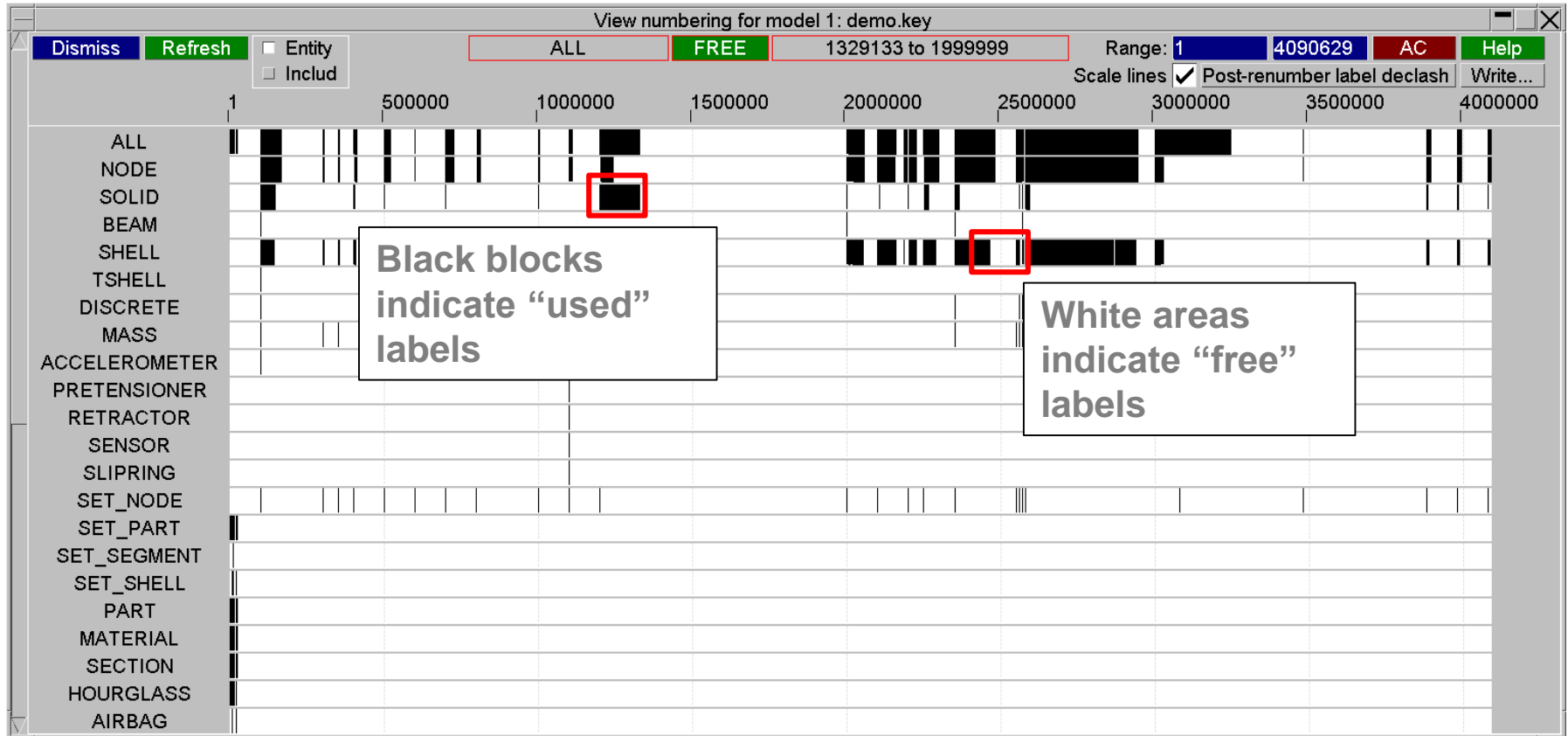
<input type="checkbox"/> mat/sect to current include
<input type="checkbox"/> mat/sect to include of parent pid

# Visualise Labels

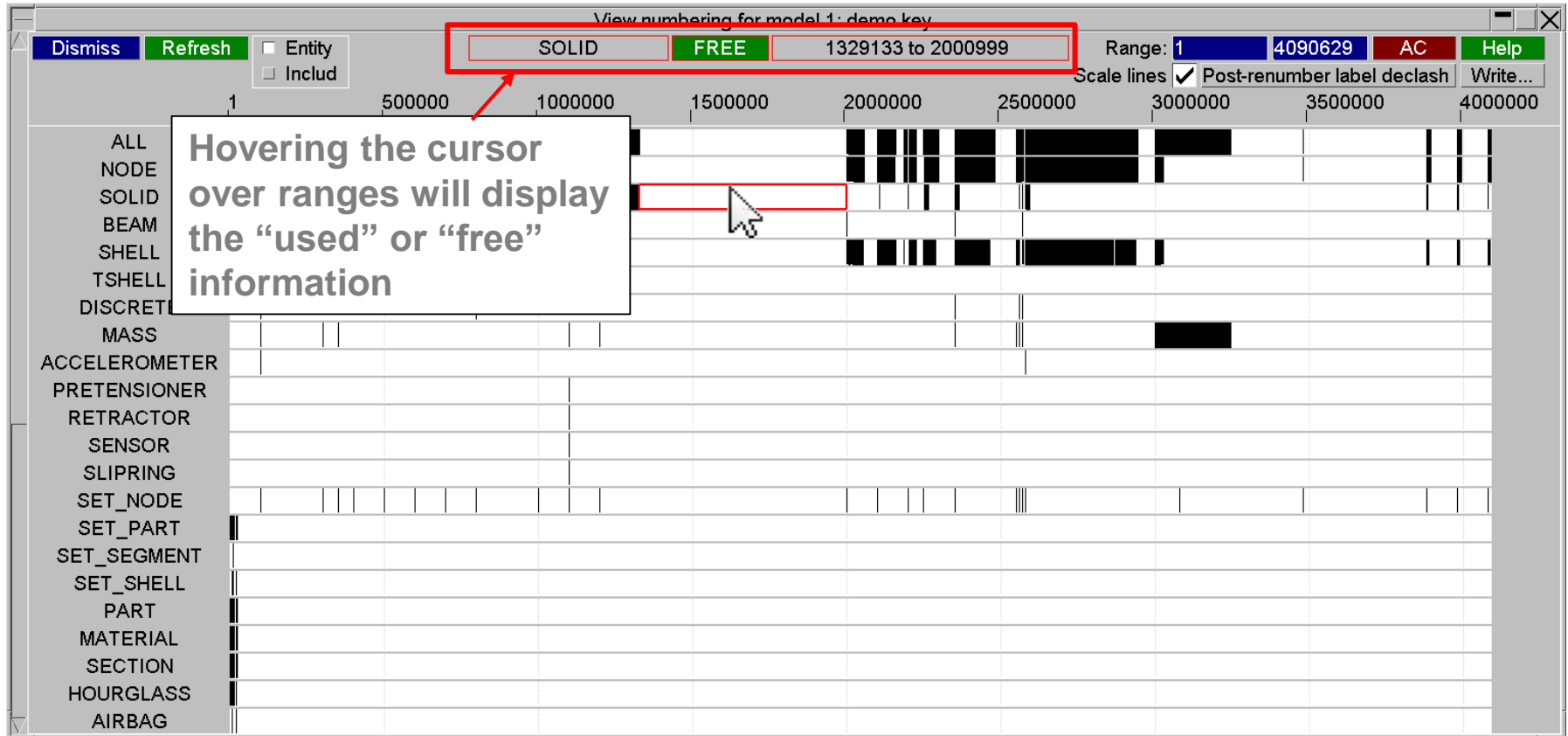
“Entity” mode: labels are displayed according to entity type (Node, Solid, Shell...).



# Visualise Labels

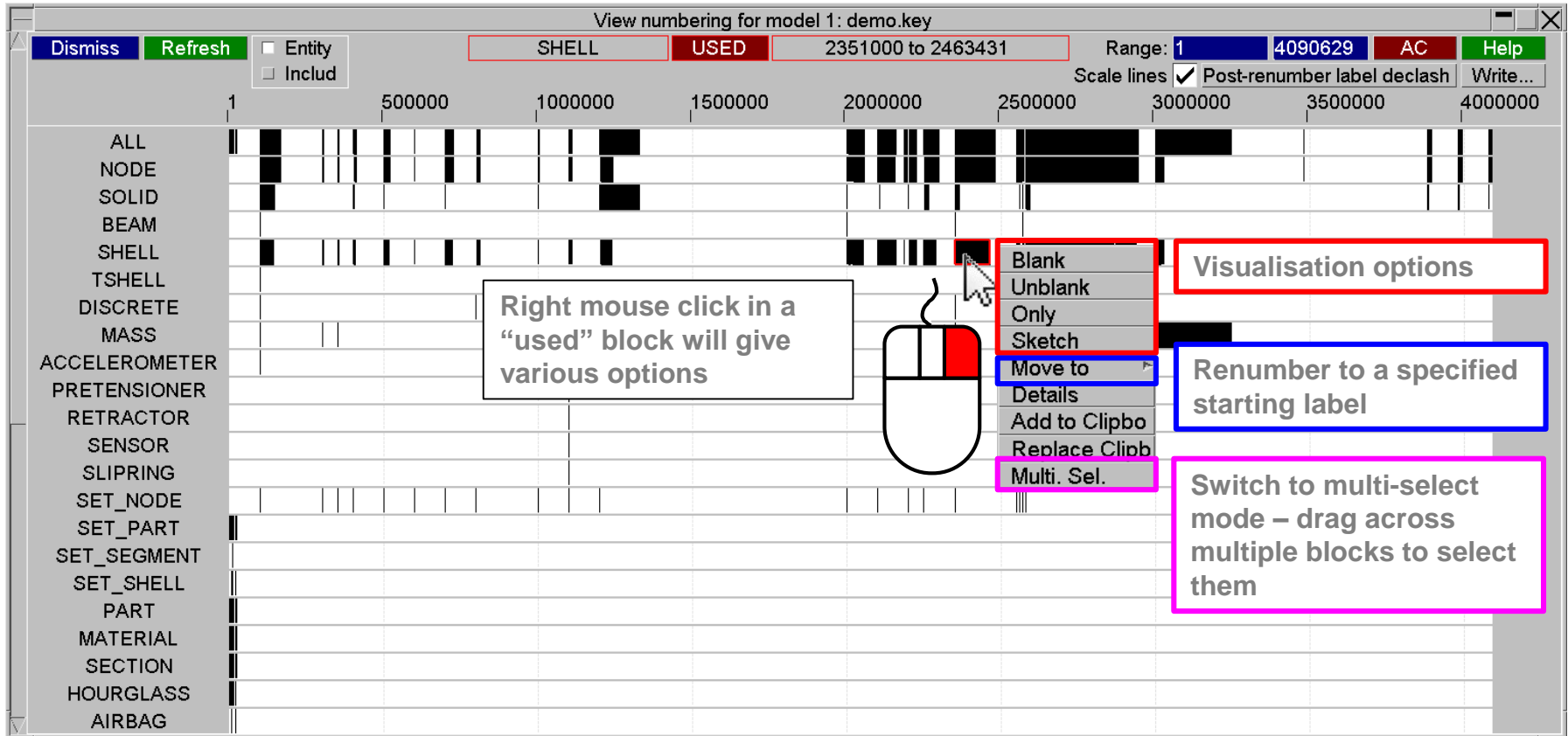


# Visualise Labels

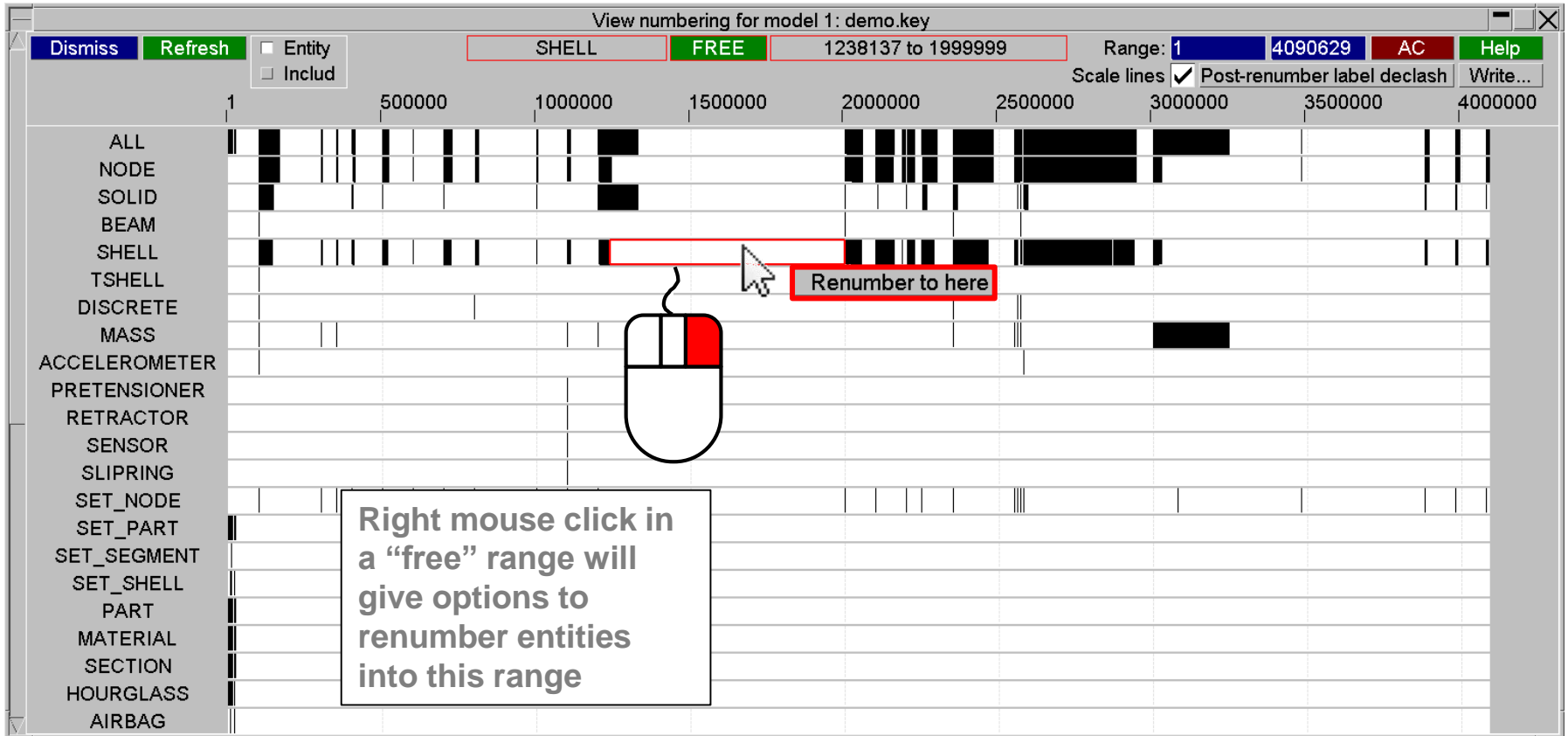




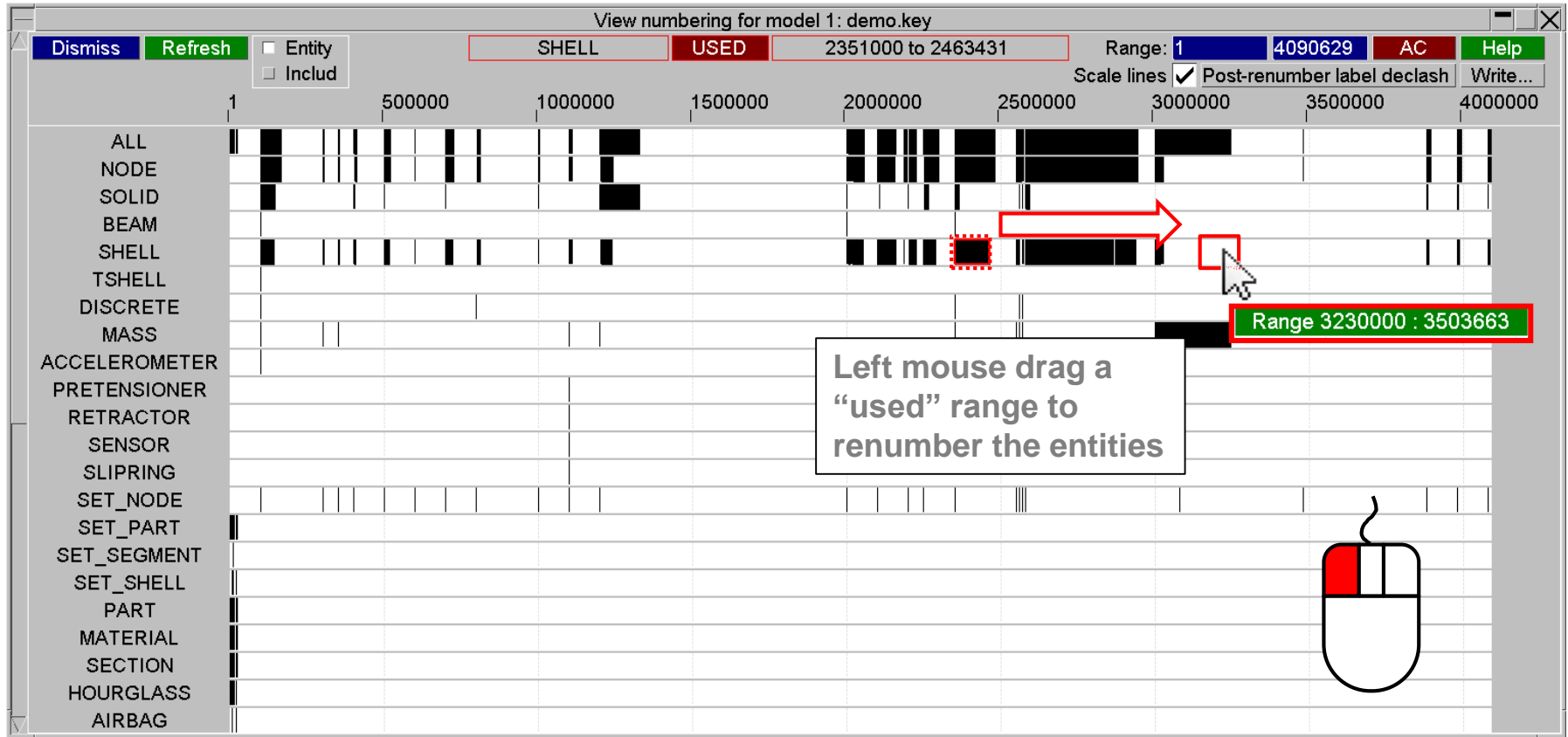
# Visualise Labels



# Visualise Labels



# Visualise Labels



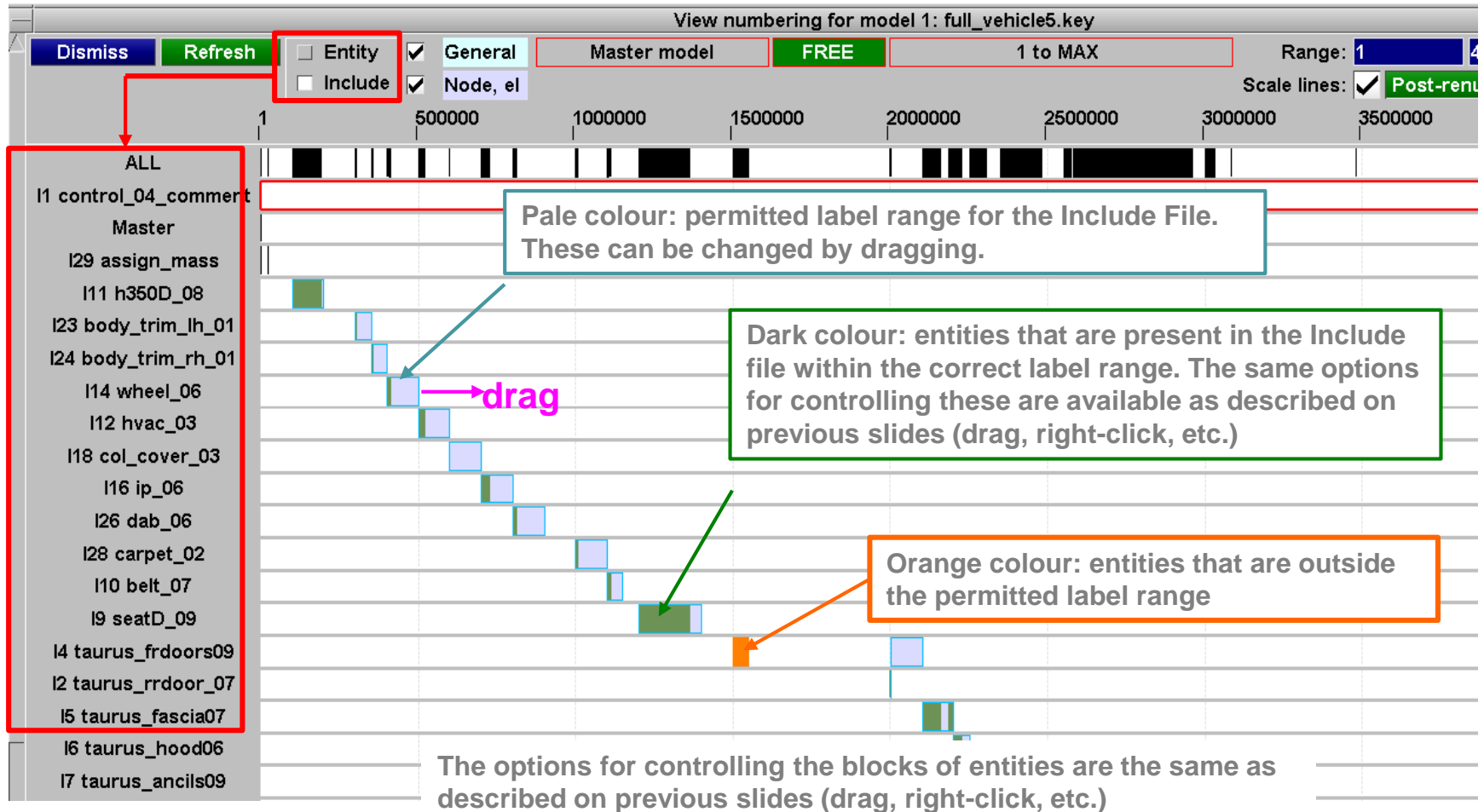
# Visualise Labels

Control of numbering scale (horizontal axis):

The screenshot shows a software window titled "View numbering for model 1: demo key". At the top, there are buttons for "Dismiss", "Refresh", and "Entity" (with a checkbox), and a "Help" button. A red box highlights the "Range" field, which contains "1" and "4090629", with the text "Type the axis limits...." overlaid. Below the range field are buttons for "AC" and "Write...". The main area is a grid with a horizontal axis labeled from 1 to 4,000,000 in increments of 500,000. The vertical axis lists various entity types: ALL, NODE, SOLID, BEAM, SHELL, TSHLL, DISCRETE, MASS, ACCELEROMETER, PRETENSIONER, RETRACTOR, SENSOR, SLIPRING, SET\_NODE, SET\_PART, SET\_SEGMENT, SET\_SHELL, PART, MATERIAL, SECTION, HOURGLASS, and AIRBAG. A red arrow points from the "Type the axis limits...." box to the horizontal axis. A text box in the center says "... or Dynamic pan: middle-mouse drag" and "Dynamic zoom: right-mouse drag". To the right, there are two mouse icons: the top one with a red vertical bar and a four-way arrow, and the bottom one with a red horizontal bar and a zoom icon.

# Visualise Labels

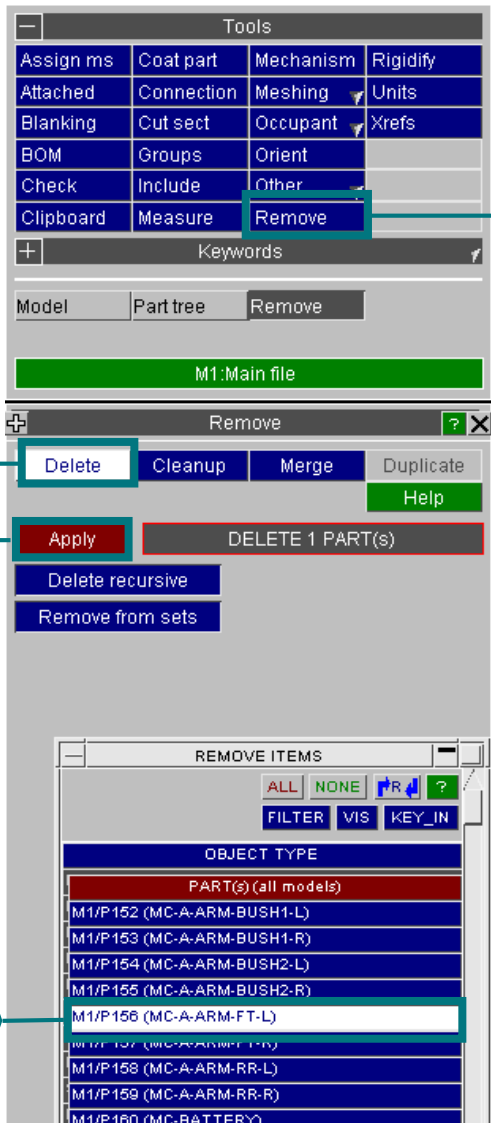
“Include” mode: labels are displayed according to Include File



# Deleting Entities – Maintaining Model Integrity

# Remove Panel

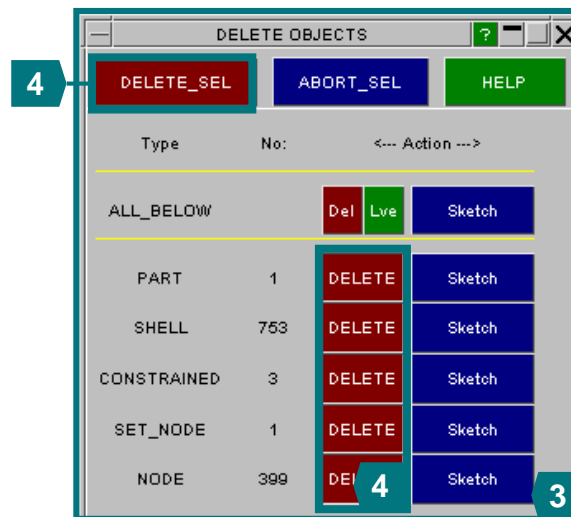
# Remove



## Remove

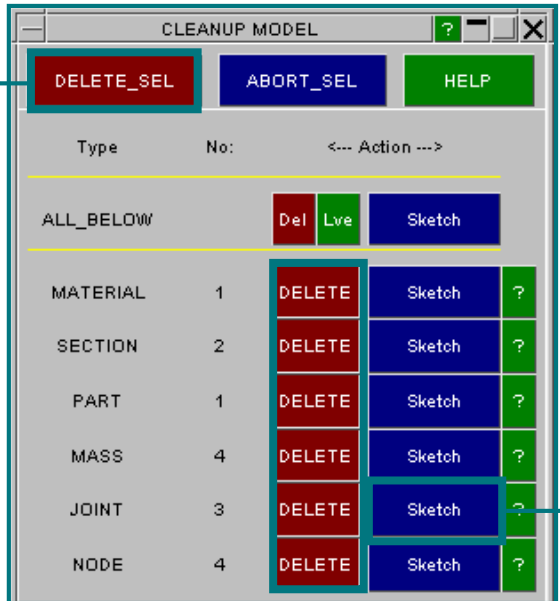
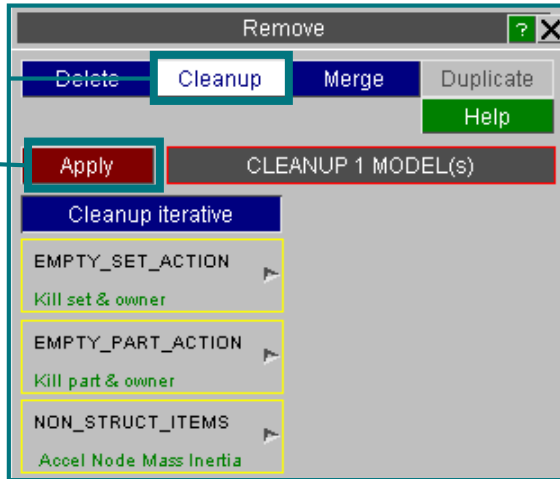
The remove function can be used to delete entities whilst maintaining the integrity of the model. First, unblank the whole model (U).

1. Go to **Tools – Remove**, to display the remove menu.
2. The **Delete** sub-menu is shown by default. Select a part & **Apply**.
3. The next menu shows what entities PRIMER decides should be deleted together with the part. *In this this example some Constrained entities are also highlighted – if left in the model these would cause an error.*
4. The user can Sketch each entry on the list and choose which types to leave undeleted. In this case delete all using **DELETE\_SEL**.





# Remove



## Remove (cont)

The **cleanup** function identifies data that is no longer needed in the model.

1. Select **Cleanup** sub-menu to remove entities that are no longer used.
2. Click **Apply**.
3. In the next menu we see what PRIMER recommends to be deleted – **Sketch** the joints to see their location. *If these joints are left in the model LS-Dyna will terminate with an error.*
4. Delete all using **DELETE\_SEL**.

# Xrefs

# X-Refs

**1** From parts menu, **Edit** a part.

**2** **VIEW\_XREFS** will open the Cross reference viewer

3. The left menu contains entities that refer to this part.

4. The right menu contains entities that this part refers to – right click & open – we can see that only 1 parts references this material

**X-Refs (Cross reference)**

Linkage (cross references) between entities may be viewed using Xrefs.

**Other entities that refer to this one**

**Entities referred to by this one**

# Investigating and Creating Mass

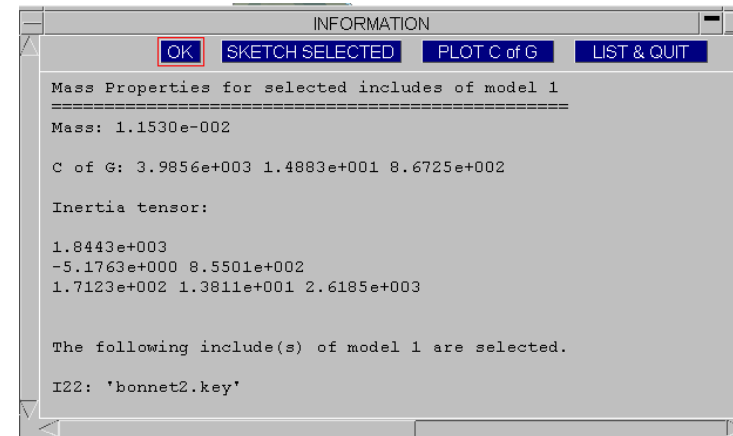
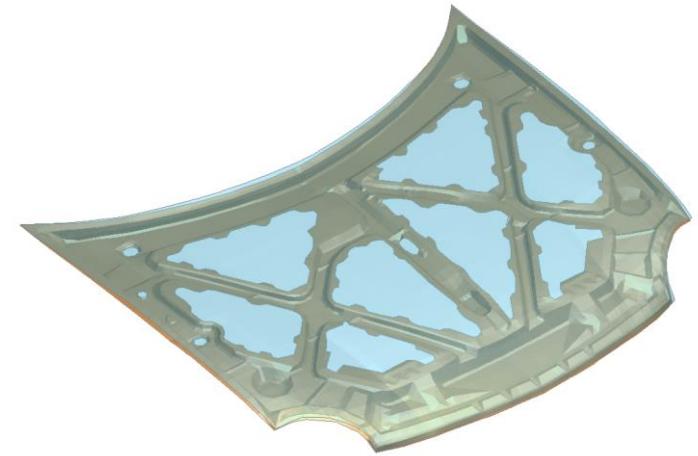
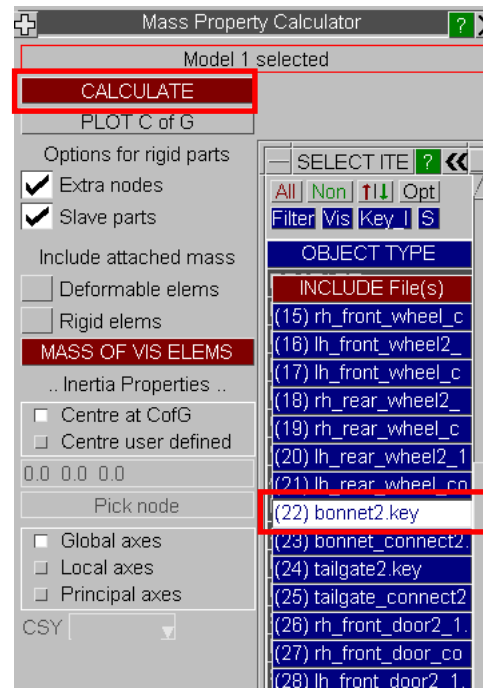
# Mass Properties

# Mass Properties

- The “Mass Properties” function can be used to calculate mass properties of selected entities.

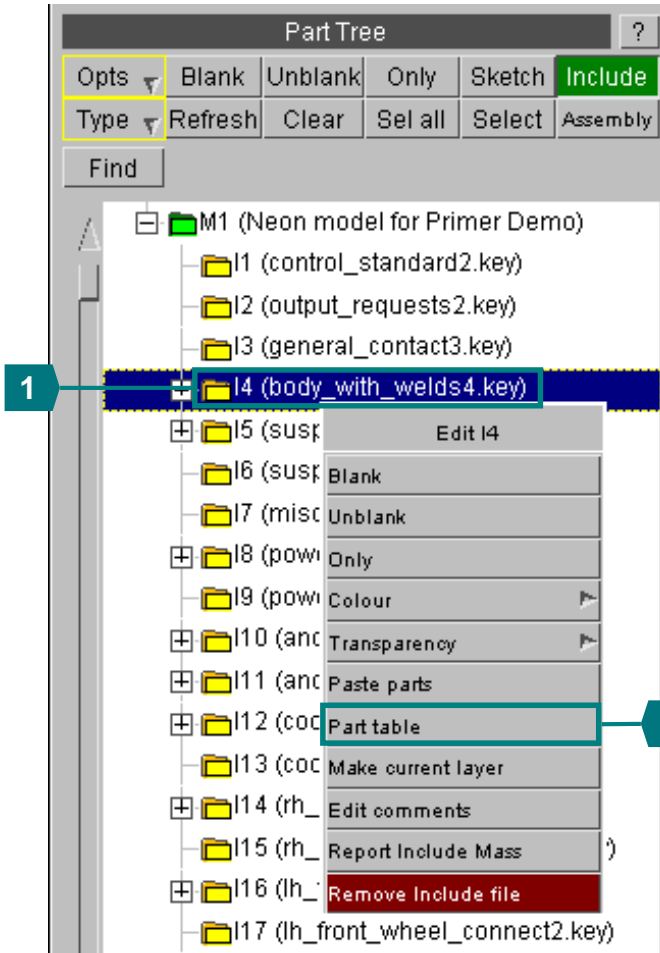
## Find

- In the Tools menu, click **Mass Prop.**
- Select **INCLUDE FILE** in the selection menu. Choose **(22) bonnet2.key**.
- Click **CALCULATE**. PRIMER will calculate mass properties of the include based on the settings on the panel, and report the result.
- Various options are available for how to handle attached mass, and inertia calculations.



# Part Table

# Part Table



PART TABLE

Dismiss View... Refresh Write... Table Changes: Undo Apply Mass in table: 0.217077 ?

Part ID	Model	HG Coeff	<input checked="" type="checkbox"/> Part Mass	Include	Ed Mass	NIP	Elform
	<input checked="" type="checkbox"/> Part ID	<input checked="" type="checkbox"/> Mat ID	Lumped Mass	Dismiss	43142]		
	<input checked="" type="checkbox"/> Part title	Mat title	<input checked="" type="checkbox"/> Added Mass		207e-008	3	2
	Part type	Mat type	Added Mass %			3	2
281	Section ID	Yield	C of G		323e-006	3	2
282	Section title	Modulus	Inertia (XX,YY,Z		374e-006	3	2
283							
284							
308	<input checked="" type="checkbox"/> Gauge	Density	Inertia (XY,XZ,Y		569e-005	3	2
309	<input checked="" type="checkbox"/> NIP	EOS ID	Blanking		761e-005	3	2
310	<input checked="" type="checkbox"/> Elform	Struct Mass	Colour		752e-005	3	2
311	HG ID	Assign Mass	Transparency		483e-005	3	2
312	HG Type	NS Mass	Style		675e-005	3	2
313	CH-A-PILLAR-BRKT1-R	2.159000	155	0.00036921	1.3138e-005	3	2
314	CH-A-PILLAR-BRKT3-L	2.147000	156	0.00015730	1.28988e-006	3	2
315	CH-A-PILLAR-BRKT3-R	2.147000	157	0.00015737	1.29027e-006	3	2
316	CH-A-PILLAR-BRKT4-L	2.805000	158	0.00012169	0	3	2
317	CH-A-PILLAR-BRKT4-R	2.805000	159	0.00012169	0	3	2
318	CH-A-PILLAR-I-L	1.561000	160	0.00066424	3.44369e-006	3	2
319	CH-A-PILLAR-I-R	1.561000	161	0.00066426	3.43556e-006	3	2



# Part Table

## Part Table

*The table now shows the requested data.*

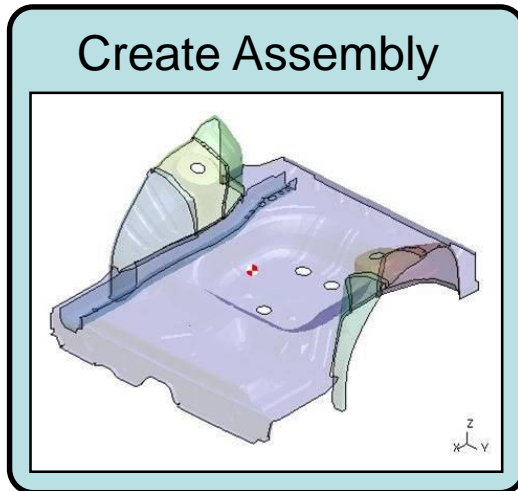
1. Click on the column heading **“Part Mass”**.  
The parts are now in order of mass, lightest at the top.
2. Click again. *Now the heaviest parts are at the top.*
3. The total mass is shown on the column heading.

Part ID	Part title	Gauge	Mat ID	Part Mass [0.202763]	Added Mass [0.0143142]	NIP	Elform
353	CH-CBN-FLOORBRD-FT	0.705000	195	0.0131395	0.000394783	3	2
354	CH-CBN-FLOORBRD-RR	0.706000	196	0.0122001	9.26798e-005	3	2
355	CH-CBN-OUTER-L	0.829000	197	0.011437	0.00028267	3	2
416	CH-ROOF	0.702000	250	0.0068424	3.09549e-005	3	2
362	CH-CBN-SILL-B	1.701000	204	0.00637916	2.13682e-005	3	2
414	CH-RAILS-U-RR-R	1.916000	248	0.00516152	4.8488e-005	3	2
410	CH-RAILS-U-RR-L	1.916000	244	0.00515992	4.84855e-005	3	2
391	CH-RAILS-FT-R-I	1.895000	225	0.0038872	0.00245228	3	2
389	CH-RAILS-FT-L-I	1.895000	223	0.00382221	0.000903256	3	2
311	CH-A-PILLAR-B-O-R	1.611000	153	0.00351327	5.43483e-005	3	2
352	CH-CBN-FIREWALL	0.735000	194	0.00344807	0.000228272	3	2
310	CH-A-PILLAR-B-O-L	1.611000	152	0.00344365	5.47752e-005	3	2
381	CH-RAD-SUPPORT-B1	1.314000	215	0.00304176	0.000217485	3	2
347	CH-CBN-DECK-SPKR-SUPP	0.960000	189	0.00287323	1.84788e-005	3	2
610	CH-RAILS-U-RR-R-REINF	2.520000	295	0.00277413	7.5753e-005	3	2
609	CH-RAILS-U-RR-L-REINF	2.520000	294	0.0027737	7.80346e-005	3	2

# Assign Mass

# Assign Mass

- Massing up an assembly:



### Input Required Mass

CREATE ASSIGN MASS in model 1

ABORT\_CREATE    RESET\_ALL    HELP

CREATE\_ASSM    COPY\_EXISTING    SKETCH

PLOT\_MASS    CHECK\_DEFN    CALCULATE

---

Create ASSIGN MASS (model 1)

Label: 1

Title:

Group menu    Group ID: 1    SKETCH

Part menu    Title:

ADD MASS TO GROUP of 0.0300 (total mass 0.0545) SHOW CG

Target CofG: X: 1200.0    Y: 0.0    Z: 558.0

Reset mass & CofG    set mass only    incl attached mass    start id: 1

Change mass and CofG by changing entire group    end id: 9999999

Change mass and CofG by changing a subset of the group    OVERM ?

Subgroup ID: N/A    SKETCH

Title:

---

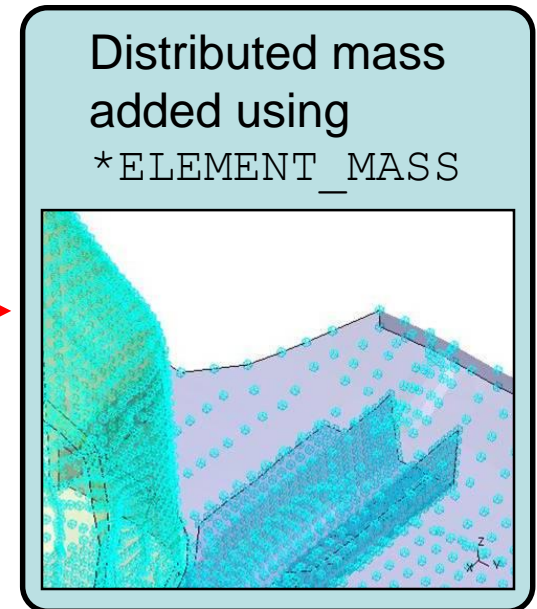
Original mass and properties of group

Actual mass:	0.0245	SHOW CG
Actual CofG: X:	1189.1	Y: -83.30    Z: 557.8
Inertia tensor: IXX:	5335.6	IY: 102.0    IXZ: 717.3
	IYY: 4418.5	IVZ: -166.1
		IZZ: 8653.4

Included mass from Part Inertias: <none>    SKETCH

Included mass from NRB Inertias: <none>    SKETCH

Excluded Part Inertia & NRB elements: <none>    SKETCH



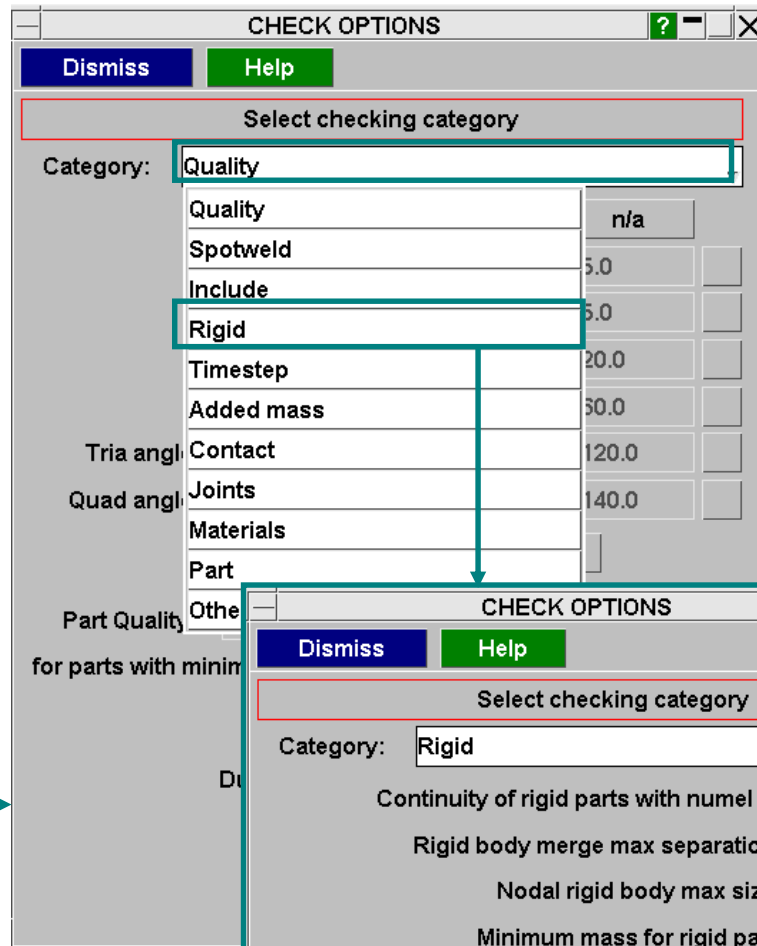
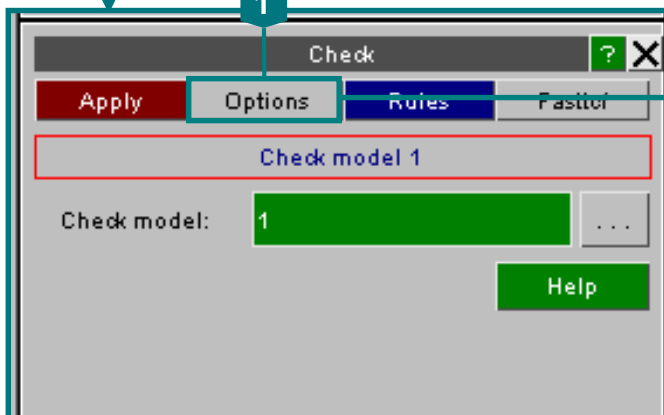
# Check Customisation

# User-defined checking options

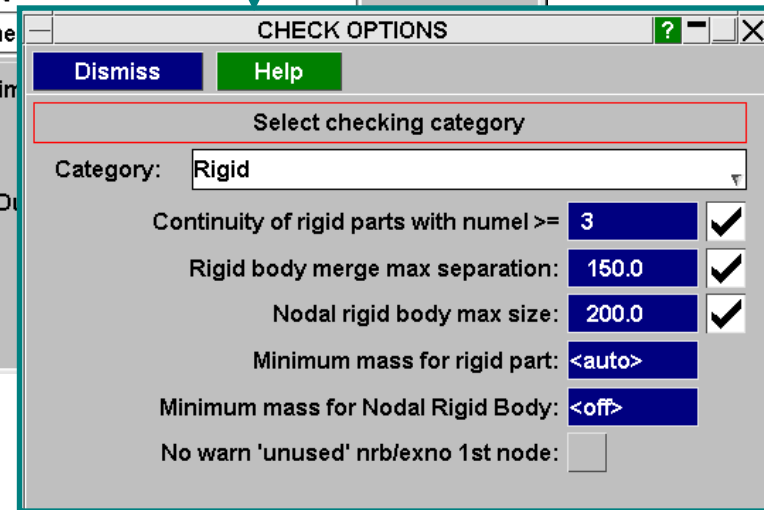
## User Defined Options:

1. To set user-defined values for some of the Error & Warning checks, click **Options** from the main check menu
2. Tick the boxes and set the desired limits – *this will apply to the current PRIMER session only*

Airbags	Clipboard	Measure	Seatbelts
Assign ms	Coat part	Meshing	Spotwelds
Attached	Dummies	Orient	Units
Blanking	FMH	Other	Xrefs
BOM	Groups	Remove	
Check	Include	Rigidify	



Use drop-down to change category



2

# User-defined checking options

**User Defined Options:**

1. For a permanent setting, use **Options, Edit prefs** from the top tool bar. *Note – this does not affect the current PRIMER session unless you then “Refresh preferences”*
2. Expand **[+] PRIMER** → **[+] checking** → **[+] model quality checks** → **[+] rigid** → **[+] Rigid body merge check** → **rigid body merge max separation**

The screenshot shows the 'Options' menu with 'Edit prefs' selected (1). The 'Preferences for PRIMER' dialog box is open, showing the 'checking' section expanded to 'rigid' and 'rigid\_body\_merge\_max\_separation' set to 250 (3). The 'PRIMER' section is expanded (2), and the 'File' menu is open (4).

# User-defined checking options

- PRIMER has a capability for customising error checking.
- A user-written file can change the status of selected errors, and add extra messages which will appear in the error log file. The user's scripts can then scan the error file for these messages and take action accordingly.
- This can be created interactively in PRIMER

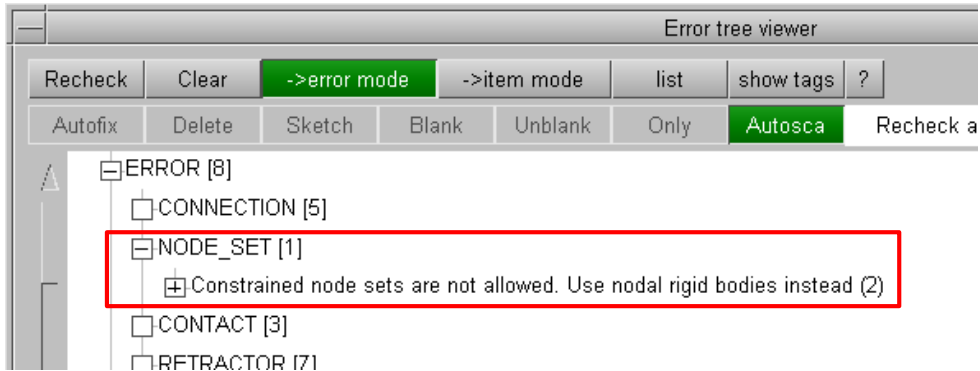
## Example file:

```
PART_122,    ERROR,    Fatal - do not run this model  
M_ST_24_07, WARNING,    Demoted to warning  
M_ST_24_10, IGNORE,
```



Error tags – identifying the selected error. The tags can be made visible in the error tree.

# User defined checks



User-defined checks are written in Javascript and kept in \$OA\_INSTALL (or User's Home directory) \PRIMER\_library\scripts\checks

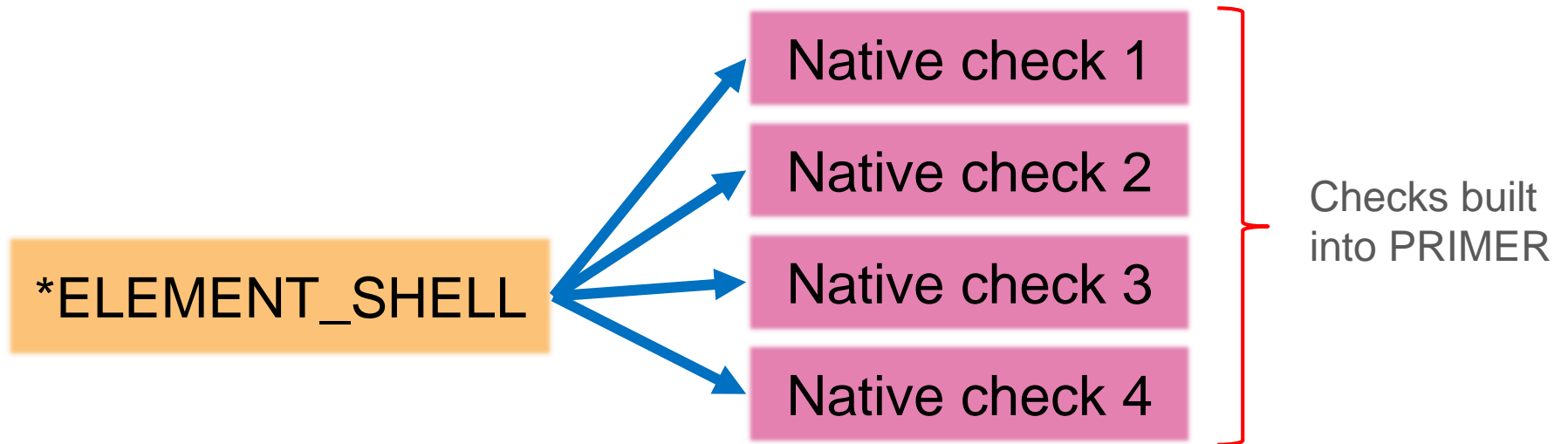
Each script must have a filename that matches the Javascript Class name for the entity type being checked (e.g. Part.js applies to every Part being checked); checks that apply to the whole model must be in a script named custom.js

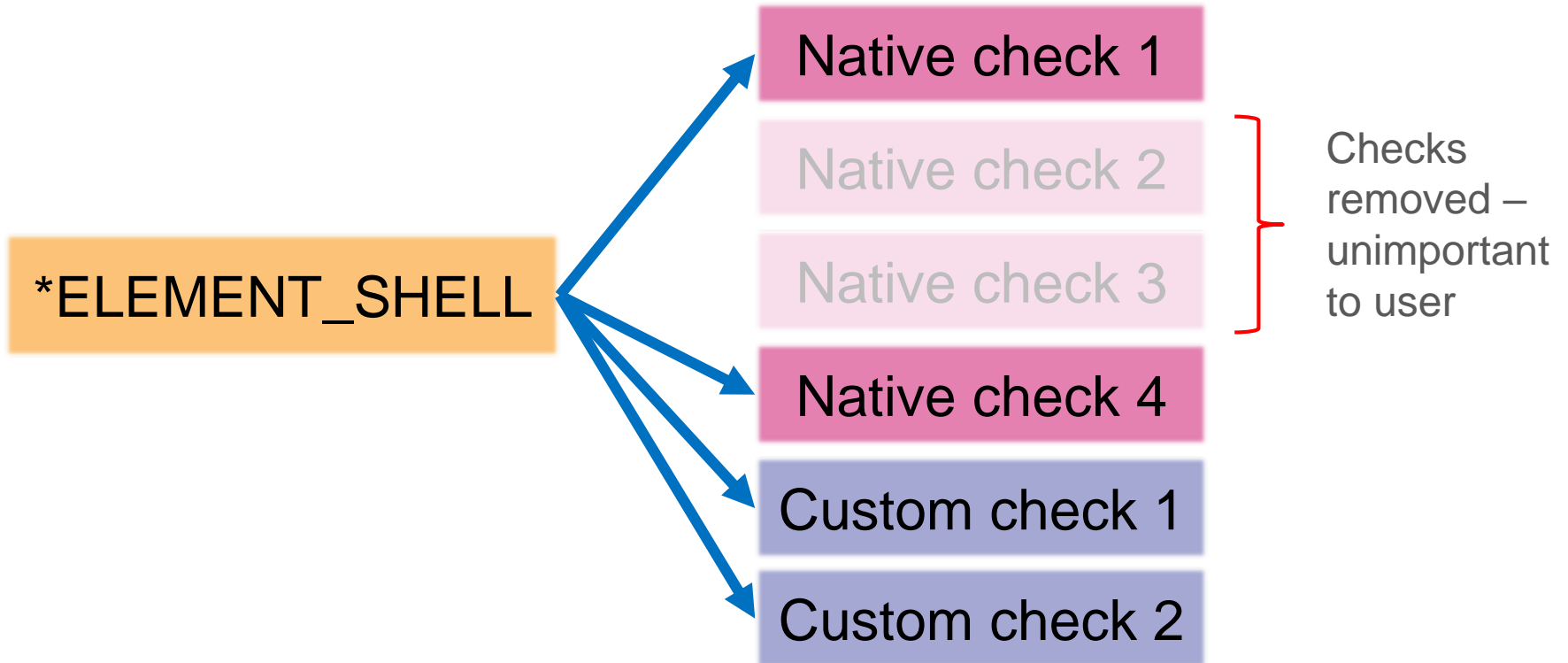
The user-defined checks are applied in addition to PRIMER's normal Model Check..

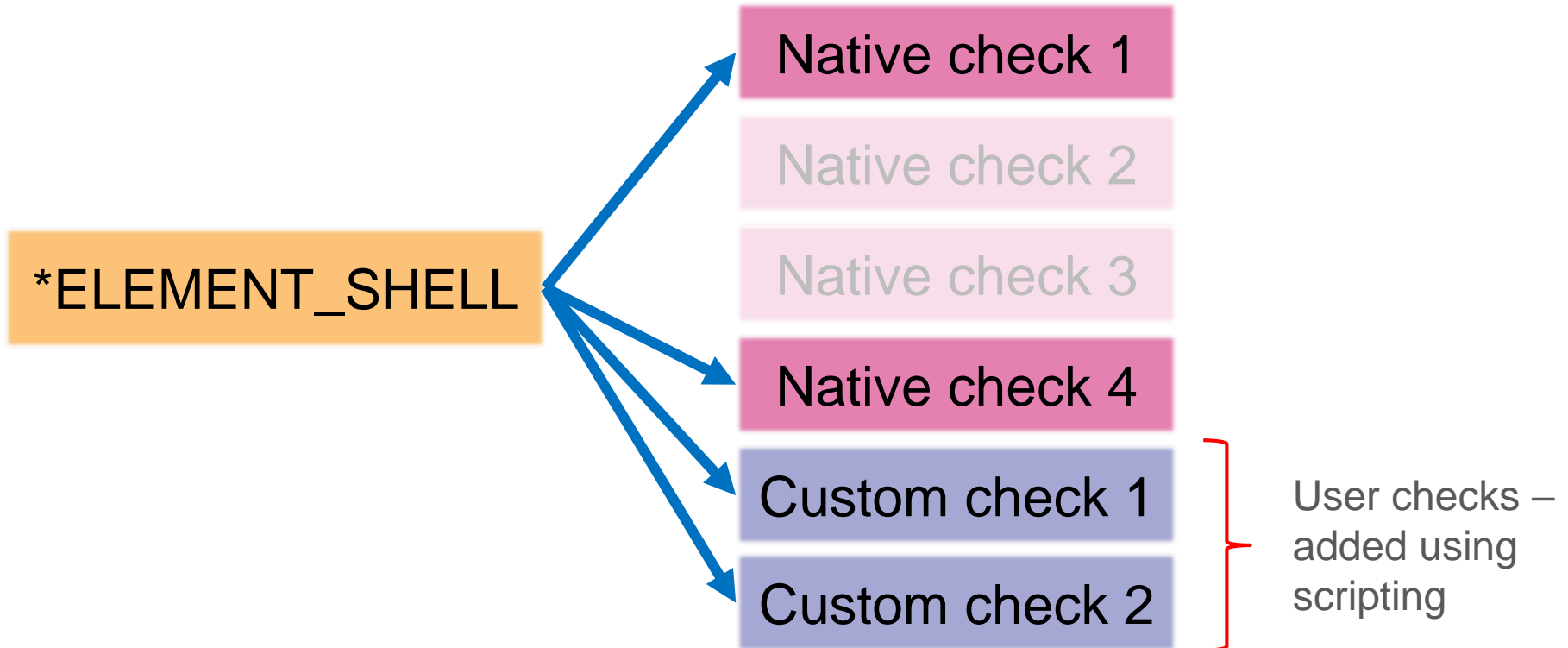
```
// arguments[0] is name of script
var m = arguments[1];           // arguments[1] is model
var ns = arguments[2];         // arguments[2] is node set

ns.Error("Constrained node sets are not allowed. Use nodal rigid bodies instead");
```









# Dashboard for model checking and health

Colours indicate the status of each check/metric.

File:   5 OK 5 Warning 3 Fail

Model Health: 64 %

Date: Fri May 25 13:25:29 2018  
Model file: Test62.key  
Model dir: C:\ARUP\UPDATE\_2018\6\_DASHBOARD\  
Admin Pref File: n/a  
Install Pref File: C:\Program Files\Ove Arup\15.0\_x64\oa\_pref  
Home Pref File: C:\Users\gavin.newlands\oa\_pref  
Error Config File:

<b>Element Quality Check</b> 0 errors 1 warning <input type="button" value="Check"/> <input type="button" value="Settings"/> <input type="button" value="Details"/>	<b>Model Check</b> 6 errors 11 warnings <input type="button" value="Check"/> <input type="button" value="Settings"/> <input type="button" value="Details"/>	<b>Dyna Output Check</b> 0 errors 20 warnings <input type="button" value="Check"/> <input type="button" value="Settings"/> <input type="button" value="Details"/>	<b>Keyword Cull Check</b> 0 errors 0 warnings <input type="button" value="Check"/> <input type="button" value="Settings"/> <input type="button" value="Details"/>	<b>Model Metrics</b> 2 errors 2 warnings <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>
<b>Control cards</b> Control cards match company guidelines <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>ELFORM check</b> ELFORM check FAIL 145 problem parts <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>Error script</b> First error message Second error message <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>Instrumentation</b> Instrumentation include present <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>MAT 100 check</b> MAT 100 check FAIL 24 problem nodes <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>
<b>MAT rigid constraint check</b> MAT_20 (rigid) Contrained check PASS <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>OK script</b> Check ran OK! <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>	<b>Warning script</b> Single warning message <input type="button" value="Check"/> <input type="button" value="Edit..."/> <input type="button" value="Details"/>		

# Oasys PRIMER

## Model Checking & QA

