

AUTOMATED CHECKLIST FOR INTERMEDIATE DELIVERIES

Julien BARBIER
Groupe PSA, France

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ABSTRACT –
During model assembly process for vehicle models (in NVH, Durability and Crash perimeters), intermediate deliverables are required. ANSA checks must guarantee their quality. These checks were manually performed and without any tool to insure the correct process and robustness.

Thanks to ANSA python scripting capabilities, we were able to automate all these checks into only one toolbox. The tools allow users either to perform checks interactively into ANSA, and then to easily correct errors, or to automatically generate an excel file that contains validation report.

This automation allows us to save time on model checks and insure that model quality is best in class. The automatic report allows an easy check and a quick overview of an ANSA model even without having to open it.

1. MESH VALIDATION

First step of model building process is mesh realization. In our current process, CAD are automatically meshed on our PLM system that is linked to ANSA. CAD files are transferred to ANSA and the Mid Surface creation is performed in batch mode. Then, all the PLM attributes are filled in ANSAPART attributes. That allow us to store PLM information (as references, materials data...) directly into the ANSA files. Once this step is performed, the ANSA batchmesher creates a preliminary mesh following our requirements and save the ANSA file directly under a specific PLM object of the part.

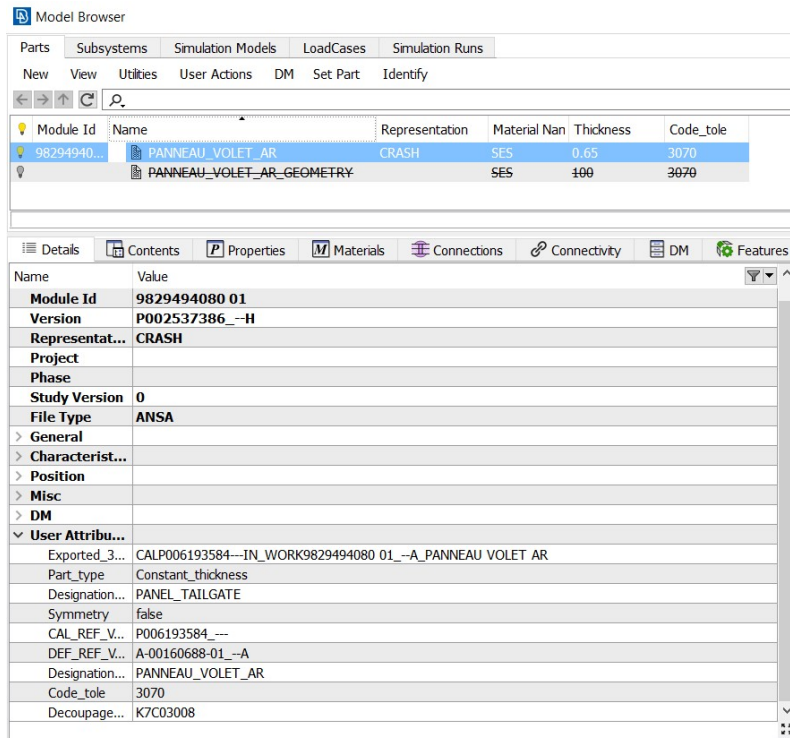


Figure 1 - Mesh File Organisation

In order to completely fulfil our mesh requirements, manual corrections are then performed on the meshes to remove all the failing elements. When meshes are finally corrected, they can replace preliminary mesh with a validated status into PLM.

Mesh validation was previously manually performed. Thanks to ANSA capabilities, we are now able to check all ansa files automatically and to generate an excel report. The only selections that must be done by the users are the meshing folder and the synoptic file selection.

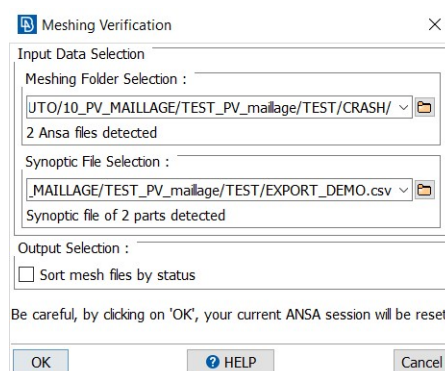


Figure 2 - Meshing Verification Input Window

8 BEFORE REALITY CONFERENCE

After the input data selection, the tool opens all ansa files and performs the checks. The following items are checked and shown in the report:

- Number of failing Elements
- Number of Elms that do not respect the Trias/Node criteria
- Number of Litigious Elements
- Triangles %
- Number of Errors on Negative Volume
- Number of Errors on Duplicated Elements
- Number of Errors on Free Nodes
- Number of Errors on Orientation
- Number of Intersections
- Number of connectivity groups (must be equal to 1 if all elements are linked)
- Filename corresponding to attributes
- Error on Part organization (must contain one geometry part and one meshing part)
- Mesh Position (part must be meshed on part local axis)
- Thickness Definition (Thickness must not be set in elements card)
- Synoptic conformity (check if the ansapart attributes are corresponding to the PLM BOM)
- Snapshot (clicking on it will open it in a bigger resolution)

Following the checks, an excel report is output with one line by ansa file. A column "status" allows to know if the meshing files are ok or not. A snapshot of each part is present too with one annotation by PID that contain its name and thickness and material information.



File Name	Status	Nb of fail elements	% of fail elements	Nb of elements with 3 or more than/Node	% of elements with 3 or more than/Node	Nb of Litigious Elements (N of bad triangles)	% of Litigious Elements (N of bad triangles)	Nb of Litigious elements in length (20% area)	% of Litigious elements in length (20% area)	Nb of Litigious elements in area (20% area)	% of Litigious elements in area (20% area)	Triangles % (20% area)	Negative Volume	Duplicated Elements	Free Nodes	Orientation	Intersections	Number of connectivity groups	Filename Error	Part organization	Mesh Position	Thickness Definition	Check Synoptic Conformity	Handle Surface	Snapshot	REF PSA
SUPPORT_D_MOTEUR_SQ_3823450590_00_..._P001589230---.ans	OK	4	0.35%	0	0.0%	137	11.07%	71	6.15%	10.57%	0	0	0	0	0	0	0	1	OK	OK	OK	OK	OK		9823450590.00	
SUPPORT_IAMBE_FORCE_TRAVERSE_PL-BORD_3823515590_00_..._P001589199---.ans	OK	1	0.15%	6	1.12%	93	17.45%	33	7.32%	9.78%	0	0	0	0	0	0	0	1	OK	OK	OK	OK	OK		9823515590.00	

Figure 3 – Mesh Validation Report

This tool allows to easily check and validate all our mesh files before using them into our model building process. By using it, we insure that all meshes are checked and validated with same process and that the report will be filled without any errors.

2. BODY IN WHITE COMPONENT VALIDATION

One of the deliverable of the model building team is the body in white subsystem. This subsystem is divided into several components: the bare body and one component by openings (doors, bonnet...). Its validation is mandatory before to start building synthesis models. In our previous process, its validation was manually performed by following a checklist and checking that all items are OK. This process was long and not "safe" due to the fact that it was manual and mistakes could then not be identified.

There is two different ways of using the tool, either by performing checks into ANSA and use the native check report to see the results, or performing the checks and generate an excel report.

The first way allows the user to check the model interactively and to perform auto-fix on some errors. It is more convenient to see the result in the check manager for isolating and correcting the troubles.

The second option that generates the report is used at the end of corrections in order to store the validation document with the model.

Validation for BiW

Action selection:

Only Perform Checks in ANSA

Perform Checks and Generate Report

Model representation

Crash

Fatigue

NVH 5*5

NVH 20*20

Components to be checked:

BARE_BODY

BONNET

REAR OPENING

FRONT_DOOR

REAR_DOOR

BIW

General checks:

Compress

Connectivity

MBContainer for BiW

Fusibility

All None

Component checks:

Attributes

Connections/Connectors

Standard Parts

Mesh (incl. Washer)

Unused

Geometry

Solver checks

All None

Save folder selection:

OK ? HELP Cancel

Figure 4 – Component Validation Input Window

8 BEFORE REALITY CONFERENCE

Check contents is divided into several categories:

- Attributes
 - Check if all attributes are correctly filled for ANSAPART, ANSAGROUPS...
- Assembly
 - Check the connection settings and organisation
 - Check the connector settings and organisation
 - Check the A_Point definition and organisation
- MBContainer
 - Check the Model Organisation
- Mesh
 - Duplicated elements
 - Free nodes
 - Negative Volume
 - Mesh quality
 - Washer specific meshing
- Standard Parts
 - Check that the standard parts that have been integrated in the model stayed unmodified
- Unused
 - Undefined entities
 - Auxiliary nodes
 - Compress entities
- Geometry
 - Check of the model intersections and penetrations
- Solver Checks
 - Headers
 - Material conformity to PSA Standard Material Database
 - Properties definition compared to PSA Standards
 - Boundary Conditions
 - Rigid dependencies

Type	Message Code	Entity ID	Description	Auto Fix	Number
BARE_BODY : Standard P...		BARE_BODY : Standard Parts	BARE_BODY : Standard Parts		
▶ BARE_BODY : Penetrations		BARE_BODY : Penetrations	BARE_BODY : Penetrations		
▶ BARE_BODY : Connectors		BARE_BODY : Connectors	BARE_BODY : Connectors	Yes	
▶ BARE_BODY : PSA_conne...		BARE_BODY : PSA_connection	BARE_BODY : PSA_connection		
▶ TAILGATE : Washer Mesh		TAILGATE : Washer Mesh	TAILGATE : Washer Mesh		
▶ TAILGATE : Mesh		TAILGATE : Mesh	TAILGATE : Mesh		
TAILGATE : Undefined/Au...		TAILGATE : Undefined/Auxiliaries	TAILGATE : Undefined/Auxiliaries		
TAILGATE : Intersections		TAILGATE : Intersections	TAILGATE : Intersections		
TAILGATE : Solver Checks		TAILGATE : Solver Checks	TAILGATE : Solver Checks		
▶ TAILGATE : ANSA_GROUP		TAILGATE : ANSA_GROUP Attributes	TAILGATE : ANSA_GROUP Attributes		
▶ TAILGATE : ANSAPART A...		TAILGATE : ANSAPART Attributes	TAILGATE : ANSAPART Attributes	Yes	
▶ TAILGATE : Connections/...		TAILGATE : Connections/Bolts	TAILGATE : Connections/Bolts		
TAILGATE : A_Points		TAILGATE : A_Points	TAILGATE : A_Points		
▶ TAILGATE : Standard Parts		TAILGATE : Standard Parts	TAILGATE : Standard Parts		
▶ TAILGATE : Penetrations		TAILGATE : Penetrations	TAILGATE : Penetrations		
▶ TAILGATE : Connectors		TAILGATE : Connectors	TAILGATE : Connectors	Yes	
▶ TAILGATE : PSA_connect...		TAILGATE : PSA_connection	TAILGATE : PSA_connection		
▶ BONNET : Washer Mesh		BONNET : Washer Mesh	BONNET : Washer Mesh		
▶ BONNET : Mesh		BONNET : Mesh	BONNET : Mesh		
BONNET : Undefined/Aux...		BONNET : Undefined/Auxiliaries	BONNET : Undefined/Auxiliaries		
BONNET : Intersections		BONNET : Intersections	BONNET : Intersections		
BONNET : Solver Checks		BONNET : Solver Checks	BONNET : Solver Checks		
▶ BONNET : ANSA_GROUP		BONNET : ANSA_GROUP Attributes	BONNET : ANSA_GROUP Attributes		
▶ BONNET : ANSAPART Att...		BONNET : ANSAPART Attributes	BONNET : ANSAPART Attributes	Yes	
▶ BONNET : Connections/B...		BONNET : Connections/Bolts	BONNET : Connections/Bolts		
BONNET : A_Points		BONNET : A_Points	BONNET : A_Points		
▶ BONNET : Standard Parts		BONNET : Standard Parts	BONNET : Standard Parts		
▶ BONNET : Penetrations		BONNET : Penetrations	BONNET : Penetrations		
▶ BONNET : Connectors		BONNET : Connectors	BONNET : Connectors	Yes	
▶ BONNET : PSA_connection		BONNET : PSA_connection	BONNET : PSA_connection		
▶ R_L_DOOR : Washer Mesh		R_L_DOOR : Washer Mesh	R_L_DOOR : Washer Mesh		
▶ R_L_DOOR : Mesh		R_L_DOOR : Mesh	R_L_DOOR : Mesh		
R_L_DOOR : Undefined/A...		R_L_DOOR : Undefined/Auxiliaries	R_L_DOOR : Undefined/Auxiliaries		
R_L_DOOR : Intersections		R_L_DOOR : Intersections	R_L_DOOR : Intersections		

Name	Value
Representation	CRASH
GroupR_L_DOOR	100018951
R_L_DOOR	<input checked="" type="checkbox"/>

Figure 5 – Example of BIW checks results in ANSA

8 BEFORE REALITY CONFERENCE

Following the checks and correction in ANSA, an excel report can be exported. This report contains in first sheet:

- The result synthesis table (see example in Figure 6)
- A project section that contain the project name and milestone and the model name
- A picture section that contain some standard views of the checked model

Summary		Bare Body	Front Door	RL Door	Bonnet	Tailgate	10	Body-In-White
Number of External connectors		2					10	
Number of internal connectors		0					0	
Mass		0.24285 t	N/A	N/A	N/A	0.01641 t		0.30257 t
Check Result	Attributes	NOK	WARNING	WARNING	WARNING	WARNING	NOK	NOK
	Connection Definition	NOK	WARNING	WARNING	WARNING	WARNING	NOK	N/A
	Connectors	NOK	WARNING	WARNING	WARNING	WARNING	NOK	N/A
	PSA Standard Connection	WARNING	WARNING	WARNING	WARNING	WARNING	WARNING	N/A
	MBCContainers	N/A	N/A	N/A	N/A	N/A	N/A	WARNING
	Mesh	NOK	WARNING	WARNING	WARNING	WARNING	NOK	NOK
	Unused	WARNING	WARNING	WARNING	WARNING	WARNING	WARNING	NOK
	Geometry	NOK	WARNING	WARNING	WARNING	WARNING	NOK	OK
	Solver Checks	NOK	WARNING	WARNING	WARNING	WARNING	NOK	OK
	Assembly	N/A	N/A	N/A	N/A	N/A	N/A	NOK
	Standard Parts	N/A	OK	OK	OK	OK	NOK	N/A
	Impactors	N/A	N/A	N/A	N/A	N/A	N/A	WARNING

Figure 6 – BIW Result Synthesis

The second sheet contains the complete BIW subsystem results (if the subsystem was present in the model). This allows to check the assembly between the components (bare body, doors...). A picture of each connectivity group of the model is displayed in order to easily check what is not fully linked in the model.

Finally, one sheet by component contains the full check report. For each category, one line by check is present with its status and some comments (see Figure 7). All these information are automatically filled by the tool. Then, the user can manually fill a last column with remarks for each checks if needed.

Category	Check	Status	Message
CONNECTIVITY	IS No specific container	OK	
	Status	OK	
	Search Option	OK	
	Match option	ERROR	Match option is not supported for this type of connection
	String	ERROR	1 connection where string 1 contains 2 is not valid
	Angle	OK	
	Connectivity per A-Point	OK	
	Axis for groups	OK	
	Spring properties	OK	
	Quality	OK	
MESH	Duplicated elements	WARNING	101 entities to compress
	Free Nodes	ERROR	230 free nodes found in the model
	Wishers	ERROR	All wishers not have a connection
	Negative Volumes	OK	
UNDEFINED	AUXILIARIES	OK	
	COMPRESS	WARNING	Test not performed
	INTERSECTIONS	OK	
GEOMETRY	Penetration with 0.5mm gap	ERROR	258 penetrations (part thickness with 0.5mm gap) without standard parts found
	Variable Gap penetration <0.8mm	ERROR	4505 penetrations (part thickness <0.8mm) without standard parts found
	Std Parts Penetration with 0.5mm Gap	ERROR	59 penetrations (part thickness with 0.5mm gap) without standard parts found
	Std Parts Penetration <0.8mm	ERROR	1542 penetrations (part thickness <0.8mm) without standard parts found
NASTRANCHECKS	Header	OK	
	Materials	OK	
	Windscreens properties	ERROR	204 elements are not defined in the model
CONNECTION	BCS	OK	
	NASTRAN LOOP	OK	
	Door strikers	WARNING	Test not performed
REAR DOOR CHECKS	Header	OK	No need to check
	Materials	OK	No need to check
	Windscreens properties	OK	No need to check
	BCS	OK	No need to check
	RIGID DEPENDANCIES	OK	No need to check
	RBODY Inertia	OK	No need to check
	RBODY Master nodes	OK	No need to check
	T8 Spring length	OK	No need to check
	T13 Spring length	OK	No need to check
	T13 Spring inertia	OK	No need to check
DEPENDANCY/NASTRAN LOOP	OK	No need to check	
Door strikers	OK	No need to check	
Standard Parts / Component	Name	OK	Rear Opening
	Module Id	OK	
	Representation	OK	
	Designation	WARNING	User/Designation_FR is not standard
	Sub-groups	OK	1 sub-group is not defined for this part: BUSHING
	Name	ERROR	Name could not be designated FR to EN
	Module Id	ERROR	Part Module Id are not coherent for 11 ASSEMBLY
	Representation	OK	
	Designation FR/EN	ERROR	Designation is not defined for 1 ASSEMBLY
	Number of connection parts	OK	
	Name of connection part	OK	
	Representation	OK	
	Module Id	ERROR	The Module Id of both connection parts are not linked
	Connection part completeness	OK	
	Connection part content	OK	
User/Assemblage Type	OK		
Bolt part completeness	OK		
Bolt part content	OK		
Diameters	OK		
PSA Standard Connection	Distance between connections	OK	
	Connection attributes	OK	
	Check Free Edges Distance	OK	
	Check Length Ratio	OK	
	Check Spotweld Diameters	OK	
	Check Length	OK	
	Check Angle	OK	
	Check Projections	OK	
	Check Support Number	OK	
	Distance between connection Points	OK	
Distance between bolts	OK		
Check Compatibility	WARNING	Compatibility check failed	
Curve settings for glue	OK		
Templates	ERROR	20 templates are missing	
Realization	OK		
Status	OK		
Connectivity	ERROR	18 connections not defined per part	
EQUIPEUR	EQUILIBREUR	WARNING	Part not in Model
	BUTEE_OUVRANT_AR	OK	BUTEE_OUVRANT_ARR
	SERRURE_OUVRANT_ARR	ERROR	Standard part is not identified

Figure 7 – BIW Result Details

3. EXTERNAL SUBSYSTEM VALIDATION

Except the body in white subsystem, all the other subsystems are imported into ANSA as “solver subsystems”. That means that we integrate them from a solver file to an ANSA model and we create an ANSA subsystem that contain all data. In this subsystem, we have to create the Assembly Points that will be used to assemble the subsystem with its environment. These Points are created either from Bolt or manually. At end of this subsystem creation process, we then have to validate it.

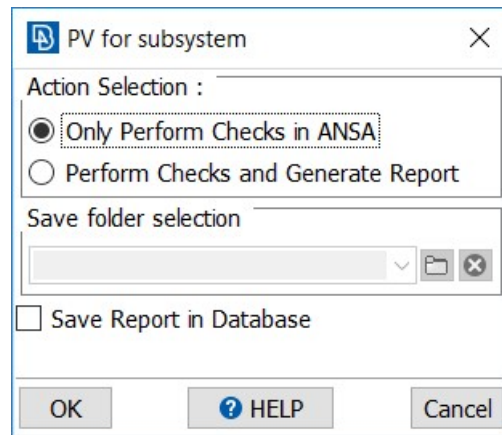


Figure 8 - Subsystem Validation Input Window

In the same way as BIW subsystem, there are several check categories:

- Attributes
 - Subsystem attributes
 - Ansapart attributes
- Assembly
 - Connections
 - Assembly Point
- MBContainers
- Mesh
 - Duplicated elements
 - Free nodes
 - Negative Volume
 - Mesh quality
- Unused
 - Undefined entities
 - Auxiliary nodes
 - Compress entities
- Geometry
 - Check of the model intersections and penetrations
- Solver Checks
 - Headers
 - Material and property solver specificities
 - Boundary Conditions
 - Rigid dependencies

8 BEFORE REALITY CONFERENCE

On the excel report, a synthesis sheet contain some generic information about the subsystem. It allows to have a good overview of the subsystem status. Furthermore, some pictures of the subsystem are shown. On these pictures, an annotation is created on each assembly point to identify them.

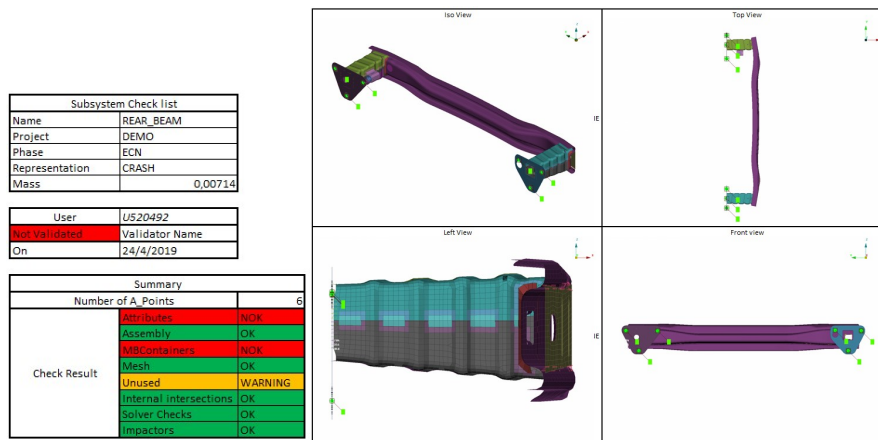


Figure 9 - Subsystem Result Synthesis

On a detailed sheet, all the results and information are present regarding the check results.

ATTRIBUTES	Subsystem	Module Id	OK		
		Representation	OK		
		File Type	ERROR	Subsystem Filetype is not correctly defined. Should be RADIOSS	
		Content Status	OK		
		Project	OK		
		Phase	OK		
	Parts	Designation	OK		
		Group Module Id	OK		
		Group Representation	OK		
		Part Module Ids	ERROR	Parts Module Id are not coherent for 1 ANSAPARTs	
		Part storage	ERROR	1 ANSAPARTs are not stored into the main ANSAGROUP	
		Parts Representation	ERROR	Parts Representation are not coherent for 1 ANSAPARTs	
		Version	ERROR	Parts Version are not coherent for 22 ANSAPARTs. Should be ECN_---	
ASSEMBLY	CONNECTIONS	Designation FRIEN	ERROR	Part Designations are not coherent for 3 ANSAPARTs	
		Decoupage PSA	ERROR	Part DEC_PSA attributes are not correctly defined for 1 ANSAPARTs. Should be SAC_APPR	
		POINTS	Connection part	OK	
			Connection part content	OK	
			Connection storage	OK	
			Bolt part	OK	
			Bolt part content	OK	
			Bolt storage	OK	
			Status	OK	
			Storage	OK	
			Name	OK	
			Missing A_Point	OK	
	A_Point on free nodes		OK		
RADIOSS -> Rigid definition	OK				
RADIOSS -> Apoint on master	OK				
Status	OK				
FUSIBILITY			To be checked on next sheet for RADIOSS		
MB Containers		ERROR	1 ANSAPART without MBContainer		
MESH	Duplicated elements	OK			
	Free Nodes	OK			
	Negative Volumes	OK			
	Mesh Quality	OK			
UNUSED	UNDEFINED	OK			
	AUXILIARIES	OK			
	COMPRESS	WARNING	4 entities to compress		
INTERSECTIONS		OK			
SOLVER CHECKS	Header	OK			
	Materials	OK			
	BCs	OK			
	NASTRAN LOOP	OK			
	DEPENDANCY	OK			
Impactor/Connectivity groups		OK			

Figure 10 - Subsystem Result Details

4. CONCLUSION

Thanks to ANSA python scripting capabilities, we were able to automate all the checks into only one toolbox. The tools allow users either to perform checks interactively into ANSA, and then to easily correct errors, or to automatically generate an excel file that contains validation report.

This automation allows us to save time on model checks and insure that model quality is best in class. The automatic report allows an easy check and a quick overview of an ANSA model even without having to open it.