

AUTOMATED CHECKLIST FOR INTERMEDIATE DELIVERIES

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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 batchmesh creates a preliminary mesh following our requirements and save the ANSA file directly under a specific PLM object of the part.

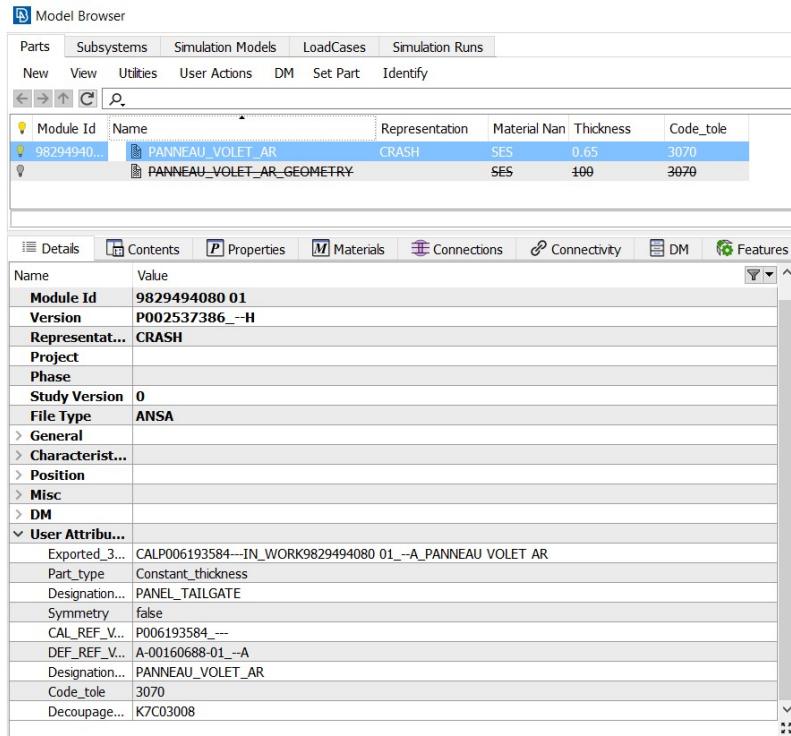


Figure 1 - Mesh File Organisation

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.

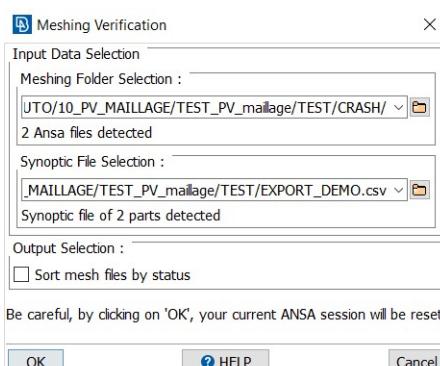


Figure 2 - Meshing Verification Input Window

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 Elems 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 elements	% of valid elements	0.0%	0	0.0%	137	11.67%	71	6.15%	10.57	0	0	0	0	0	OK	OK	OK	OK	OK	REF PSA	
SUPPORT_D_MOTEUR_SD_982345059000_---_P001589320---.ansa	Error	4	0.35%	0	0	0.0%																982345059000	
SUPPORT_JAMB_E_FORCE_TRAVERSE_PL_BORD_982351559000_---_P001589165---.ansa	Error	1	0.19%	6	1.13%	93	17.45%	39	7.32%	9.78%	0	0	0	0	0	0	1	OK	OK	OK	OK	OK	982351559000

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 are 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.

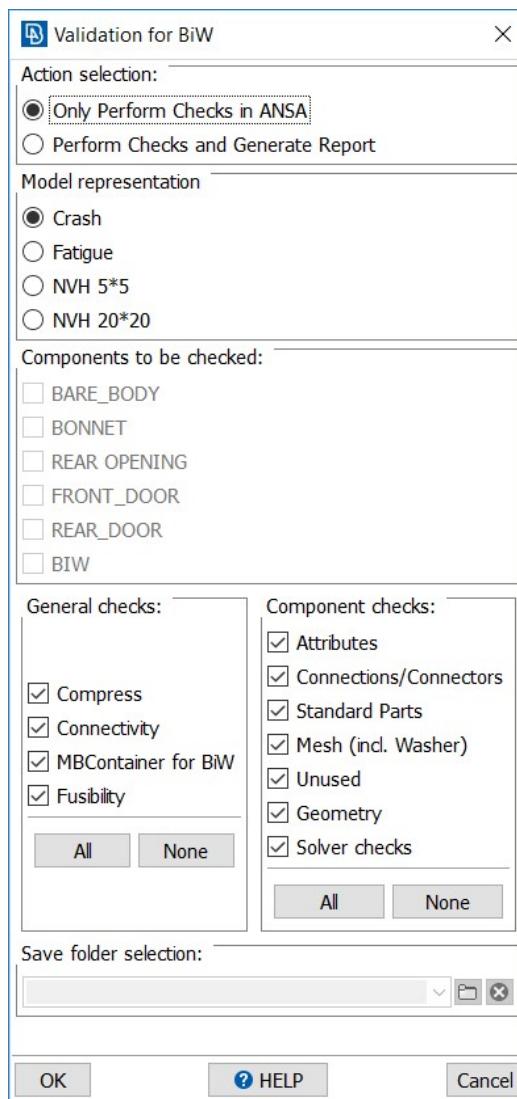


Figure 4 – Component Validation Input Window

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 : Penetrations				BARE_BODY : Penetrations		
▷ BARE_BODY : Connectors				BARE_BODY : Connectors		
▷ BARE_BODY : PSA_connect...				BARE_BODY : PSA_connection	Yes	
▷ TAILGATE : Washer Mesh				TAILGATE : Washer Mesh		
▷ TAILGATE : Mesh				TAILGATE : Mesh		
▷ TAILGATE : Undefined/Au...				TAILGATE : Undefined/Auxiliaries		
▷ TAILGATE : Intersections				TAILGATE : Intersections		
▷ TAILGATE : Solver Checks				TAILGATE : Solver Checks		
▷ TAILGATE : ANSA_GROU...				TAILGATE : ANSA_GROUP Attributes		
▷ TAILGATE : ANSAPART_A...				TAILGATE : ANSAPART Attributes		
▷ TAILGATE : Connections/B...				TAILGATE : Connections/Bolts		
▷ TAILGATE : A_Points				TAILGATE : A_Points		
▷ TAILGATE : Standard Parts				TAILGATE : Standard Parts		
▷ TAILGATE : Penetrations				TAILGATE : Penetrations		
▷ TAILGATE : Connectors				TAILGATE : Connectors		
▷ TAILGATE : PSA_connect...				TAILGATE : PSA_connection	Yes	
▷ BONNET : Washer Mesh				BONNET : Washer Mesh		
▷ BONNET : Mesh				BONNET : Mesh		
▷ BONNET : Undefined/Au...				BONNET : Undefined/Auxiliaries		
▷ BONNET : Intersections				BONNET : Intersections		
▷ BONNET : Solver Checks				BONNET : Solver Checks		
▷ BONNET : ANSA_GROUP At...				BONNET : ANSA_GROUP Attributes		
▷ BONNET : ANSAPART At...				BONNET : ANSAPART Attributes		
▷ BONNET : Connections/B...				BONNET : Connections/Bolts		
▷ BONNET : A_Points				BONNET : A_Points		
▷ BONNET : Standard Parts				BONNET : Standard Parts		
▷ BONNET : Penetrations				BONNET : Penetrations		
▷ BONNET : Connectors				BONNET : Connectors		
▷ BONNET : PSA_connect...				BONNET : PSA_connection	Yes	
▷ R_L_DOOR : Washer Mesh				R_L_DOOR : Washer Mesh		
▷ R_L_DOOR : Mesh				R_L_DOOR : Mesh		
▷ R_L_DOOR : Undefined/Au...				R_L_DOOR : Undefined/Auxiliaries		
▷ R_L_DOOR : Intersections				R_L_DOOR : Intersections		

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	Body-In-White
Number of External connectors		2				10	
Number of internal connectors		0				0	
Check Result	Mass	0.34285 t	N/A	N/A	N/A	0.01641 t	0.30257 t
	Attributes	NOK	WARNING	WARNING	WARNING	NOK	NOK
	Connection Definition	NOK	WARNING	WARNING	WARNING	NOK	N/A
	Connectors	NOK	WARNING	WARNING	WARNING	NOK	N/A
	PSA Standard Connection	WARNING	WARNING	WARNING	WARNING	WARNING	N/A
	MBContainers	N/A	N/A	N/A	N/A	N/A	WARNING
	Mesh	NOK	WARNING	WARNING	WARNING	NOK	NOK
	Unused	WARNING	WARNING	WARNING	WARNING	WARNING	NOK
	Geometry	NOK	WARNING	WARNING	WARNING	NOK	OK
	Solver Checks	NOK	WARNING	WARNING	WARNING	NOK	OK
Assembly	Assembly	N/A	N/A	N/A	N/A	N/A	NOK
	Standard Parts	N/A	OK	OK	OK	NOK	N/A
	Impactors	N/A	N/A	N/A	N/A	N/A	WARNING
	Welds	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.

Comments		Rear Opening	
Kinematic	Definition	OK	
	No specific container	OK	
Status	OK		
Search Option	OK		
Match option	WARNING [Warning matching rule 3 activation] without [Match expression]		
Axis for points	OK		
Angle	OK		
Connectivity per A-Point	OK		
Axes for pivots	OK		
Spring properties	OK		
MESH			
Quality	OK		
Duplicated elements	WARNING 101 entities to compress		
Free Nodes	WARNING 120 free nodes found in the model		
Washers	WARNING 18 bolts do not have a correct washer		
Negative Volumes	OK		
UNIFIED			
UNDEFINED	OK		
AUXILIARIES	OK		
COMPRESS	WARNING Test not performed		
GEOLOGY			
Intersections	OK		
Penetration with 0.5mm gap	WARNING 408 penetrations over thicknesses with 0.5mm gap, without shank/pins found.		
Variable Gap penetration <0.8mm	WARNING 4080 penetrations (ProjectThickness - 0.8mm), with shank/pins found.		
Std Parts Penetration with 0.5mm Gap	WARNING 1080 parts (ProjectThickness - 0.5mm), with shank/pins found.		
Std Parts Penetration <0.8mm	WARNING 1080 parts (ProjectThickness - 0.8mm), with shank/pins found.		
STRUCTURES			
Materials	OK		
Windscreen properties	WARNING [Warning material and color of windscreen property]		
BCs	OK		
NASTRAN LOOP	OK		
Door strikers	WARNING Test not performed		
ROBOTIC CHAINS			
Header	OK	No need to check	
Materials	OK	No need to check	
Windscreen properties	OK	No need to check	
RIGID DEPENDANCES	OK	No need to check	
RBD/INertia	OK	No need to check	
RBD/ Master nodes	OK	No need to check	
T13	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	
Comments		Rear Opening	
Name	OK		
Module Id	OK		
Representation	OK		
Designation	WARNING User/Designation_FR is not standard		
Sub-groups	WARNING [Warning ANSAPARTS are not stored into the main AND ANSAPARTS]		
Name	WARNING [Warning Name should be Designation FR or EN]		
Module Id	WARNING [Warning Module ID of the connection part is not unique]		
Representation	OK		
Designation FR/EN	WARNING [Warning designation for different is ANSAPARTS]		
Comments		Rear Opening	
Name	OK		
Module Id	OK		
Representation	OK		
Designation	OK		
Connection parts	OK		
Name of connection part	OK		
Representation	OK		
Module Id	OK		
Connection part completeness	OK		
Connection part content	OK		
User/Assembly/Type	OK		
Bolt part completeness	OK		
Bolt part content	OK		
Diameters	OK		
Distance between connections	OK		
Connection attributes	OK		
Check Free Edges Distance	OK		
Check Length Ratio	OK		
Check Spaweld Diameters	OK		
Check Length	OK		
Check Angle	OK		
Check Projections	OK		
Check Surface Number	OK		
IPA Standard Connection			
Distance between connection Points	OK		
Distance between bolts	OK		
Check Compatibility	WARNING [Warning compatibility check failed]		
Comments		Rear Opening	
Curve settings for glue	OK		
Templates	WARNING [Warning template exists]		
Realization	OK		
Status	OK		
Connectivity	WARNING [Warning 12 connections not defined per part]		
Comments		Standard Parts Component	
EQUILIBREUR	WARNING [Part not in Model]		
BUTEE_OUVRANT_AR	OK		
SERRURE_OUVRANT_ARR	WARNING [Warning SERRURE_OUVRANT_ARR]		

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.

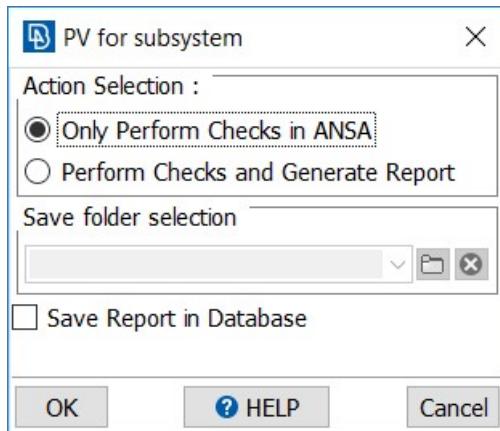


Figure 8 - Subsystem Validation Input Window

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.

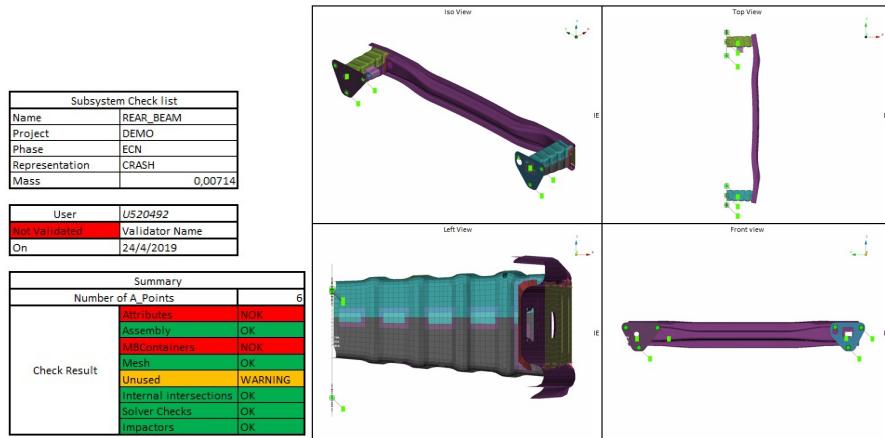


Figure 9 - Subsystem Result Synthesis

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	
		Designation	OK	
Parts	Parts	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 ---
		Designation FREN	ERROR	Part Designations are not coherent for 3 ANSAPARTs
ASSEMBLY	A_POINTS	Decoupage PSA	ERROR	Part DEC_PSA attributes are not correctly defined for 1 ANSAPARTs. Should be SAC_APP
		Connection part	OK	
		Connection part content	OK	
		Connection storage	OK	
		Bolt part	OK	
		Bolt part content	OK	
		Bolt storage	OK	
POINTS	A_POINTS	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	
FUSIBILITY		Status	OK	
		FUSIBILITY		To be checked on next sheet for RADIOSS
		MB Containers	ERROR	1 ANSAPART without MBContainer
		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	
		Header	OK	
		Materials	OK	
		BCs	OK	
SOLVER CHECKS		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.