BETA
SIMULATION SOLUTIONS

physics on screen

ANSA
PRE PROCESSOR

Part Build Process

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1. Introduction

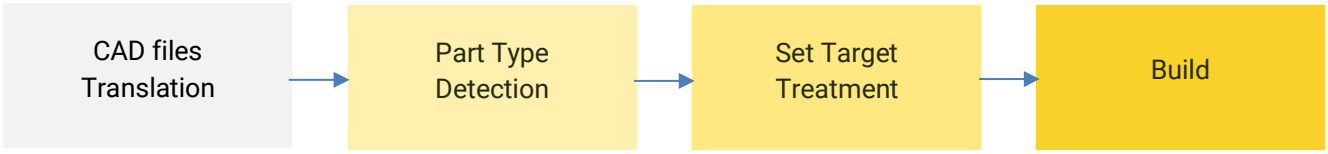
1.1. Problem Description

In today's CAE simulations, complex structures consist of several sub-parts. A modern midsized vehicle can contain more than 30000 different parts. For a CAE analysis different parts need to be treated differently and furthermore not all parts are needed for the simulation. Initially, the engineer should categorize the different parts of the model based on their type and then follow the correct series of actions that will lead to an accurate FE representation of every component. This can be a tedious process if it is performed manually for every single part of them model.

ANSA offers an integrated solution that can tackle these challenges with minor user interaction. The first step of the solution is a detection algorithm that can categorize the parts based on their shape automatically. This tool can distinguish if a part is Sheet Metal, Casting, Solid, Extruded, Fastener etc. The second step of the solution executes the correct series of actions for every different part to modify (treat) it as desired. These series of actions are defined in the form of user scripts that exist inside the ANSA package and can be easily loaded and executed through *Model Browser*.

This solution is called Part Build process. ANSA comes with a suggested Part Build process, as it is detailed described in this document. However, the Part Build is a standalone technology that is fully customizable, this means that users can create their own user scripts and define their own series of action that will be executed on every part. So, the complete Part Build process solution can be modified by the users to meet their specific requirements.

Overall Workflow



1.2. About this document

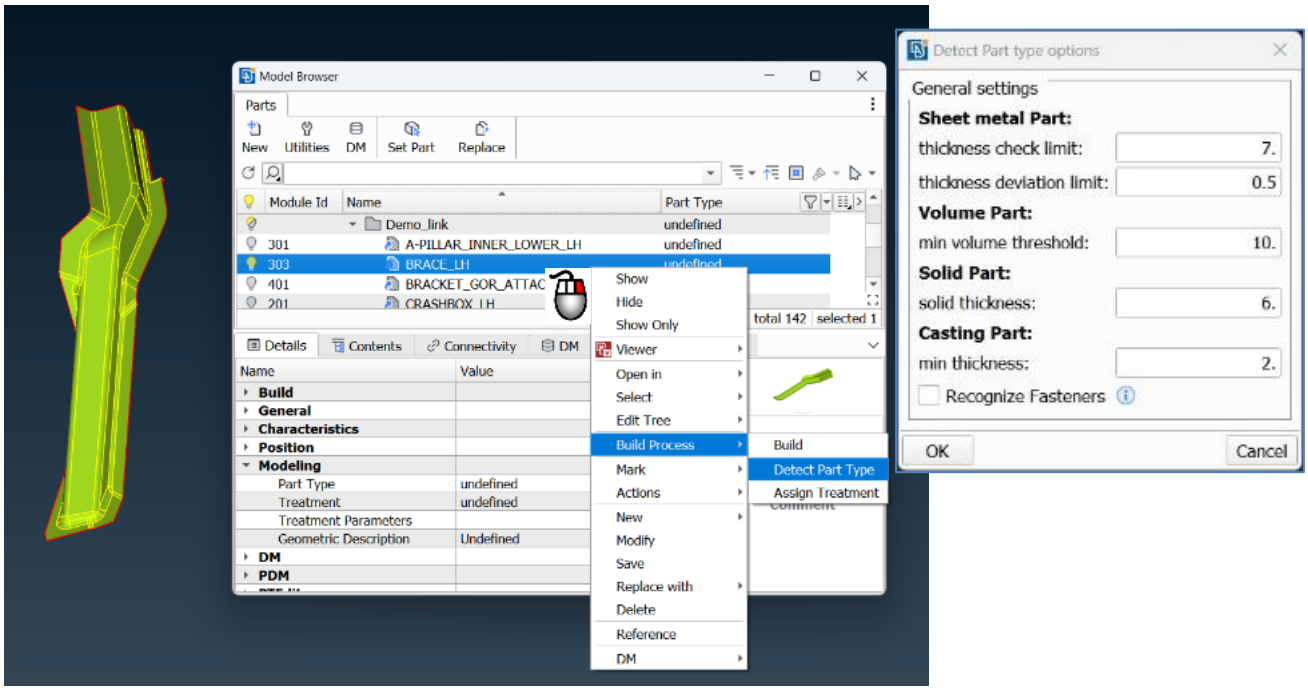
This document is a guide on the Part Build process and provides insight on the main concepts, the logic, as well as the inbuild methodologies of the process.

2. Build Process and major attributes

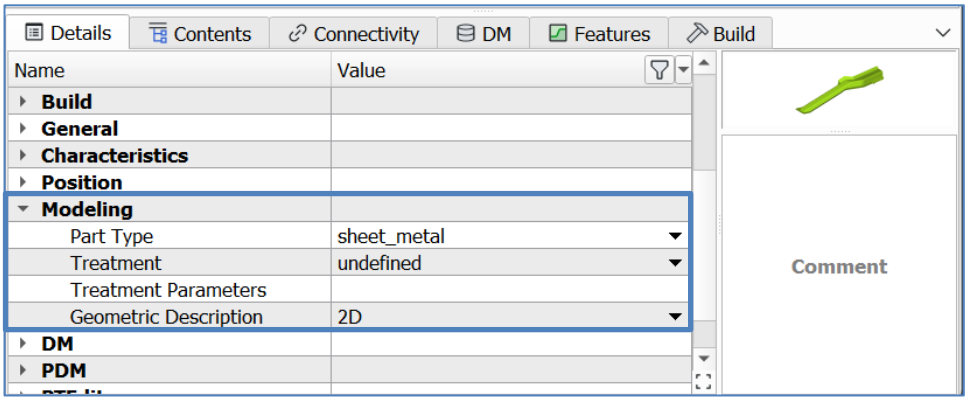
2.1. Detect Part Type

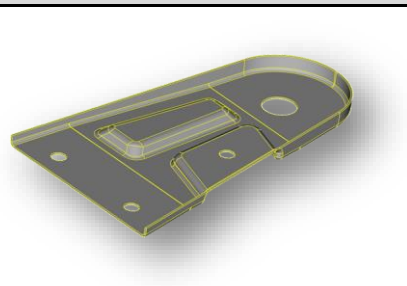
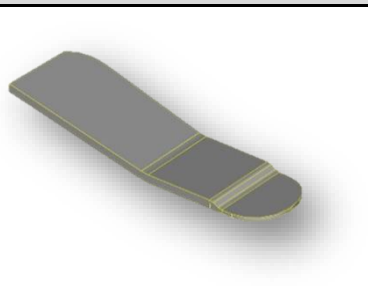
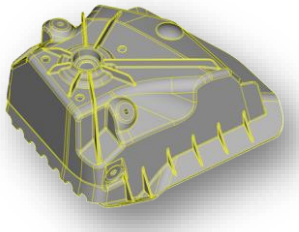
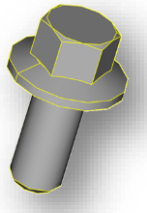
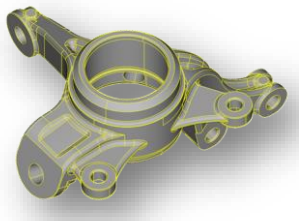
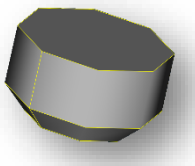
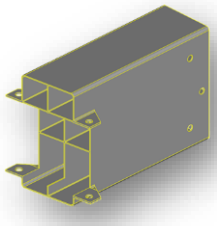
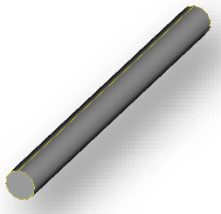
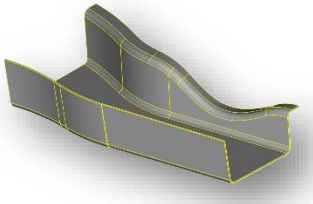
The first step of the Part Build process is the detection of every part's type. This is a necessary step that gives us knowledge about the geometrical shape of the part. If we have access to this information, we can determine the series of actions and checks that should be applied on every part to modify it accordingly. If this information is already available from the PDM system this step should be skipped, but based on experience this is rarely the case.

Open *Model Browser* and select one or more parts, use **RMB > Build Process > Detect Part Type**, the *Detect Part Type options* window opens. At this window the user can specify the threshold values for the identification.



After the execution, the type of the part has been calculated by the tool along with the information about the description of the part (if it is a 3D volume or a 2D middle surface). This information is placed at the ANSAPART attributes *Modelling > Part Type* and *Modelling > Geometric Description* accordingly.



Part Type	Table with all available Part Types		
Sheet Metal ! Parts with no ribs or thickness variation		Tailor Rolled Blank ! Sheet metal parts with a gradual thickness change	
Casting ! Complex casted parts with ribs and thickness variation		Fastener ! Bolts, rivets, screws, nuts etc.	
Solid ! Thick solid parts		Small ! Parts with a very small volume	
Extrusion ! Extruded profiles		Tube ! A standard tube or a wire	
Tailor Welded Blank ! Sheet metal parts with a distinctive gap in the thickness			

2.2. Representation – Part Type - Treatment

The Part Build process is driven by three ANSAPART attributes. These three attributes define what actions will be applied on every different ANSAPART:

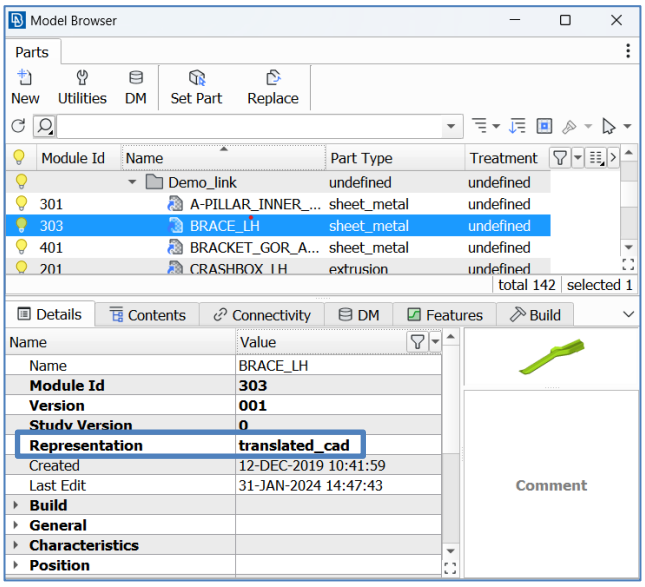
1. *Representation*: Defines the current state of the part.
2. *Modeling > Part Type*: Defines the type of the part.
3. *Modeling > Treatment*: Defines the target state that the part should reach.

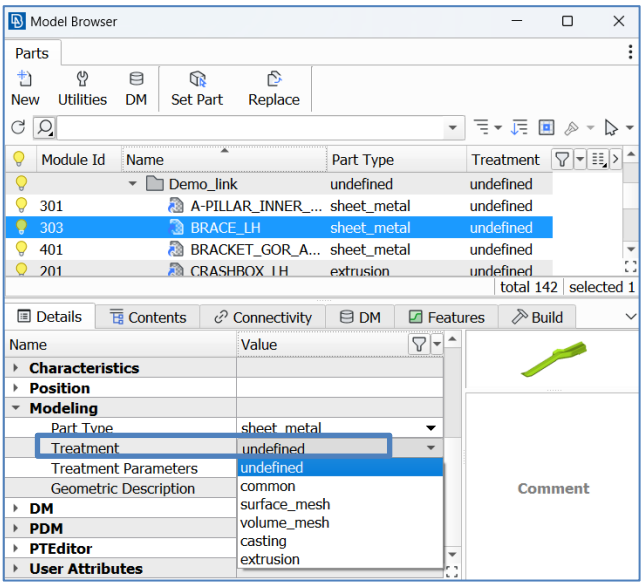
In the most general aspect of the Part Build process, we assume that every part starts from the *Representation*: translated_cad. This should be assigned to every ANSAPART to start the build process and it means that we are starting for a file that has just been translated from CAD.

It is already mentioned that the function **Detect Part Type** can automatically identify and set the type of the part under the attribute *Modeling > Part Type* (see chapter 2.1).

If *Representation* and *Modeling > Part Type* have been defined correctly, then the user needs to specify the desired target treatment for every part in the attribute *Modeling > Treatment*. This field specifies the modeling state that this component should reach.

! *Modeling > Part Type* and *Modeling > Treatment* will be referred as *Part Type* and *Treatment* in the rest of the document.





Based on the *Representation* and the *Part Type*, the user can select one of the following available *Treatments*: common, surface_mesh, volume_mesh, casting or extrusion.

! Not all *Representation*, *Part Type* and *Treatment* combinations are valid, detailed catalogue in chapter 2.4.

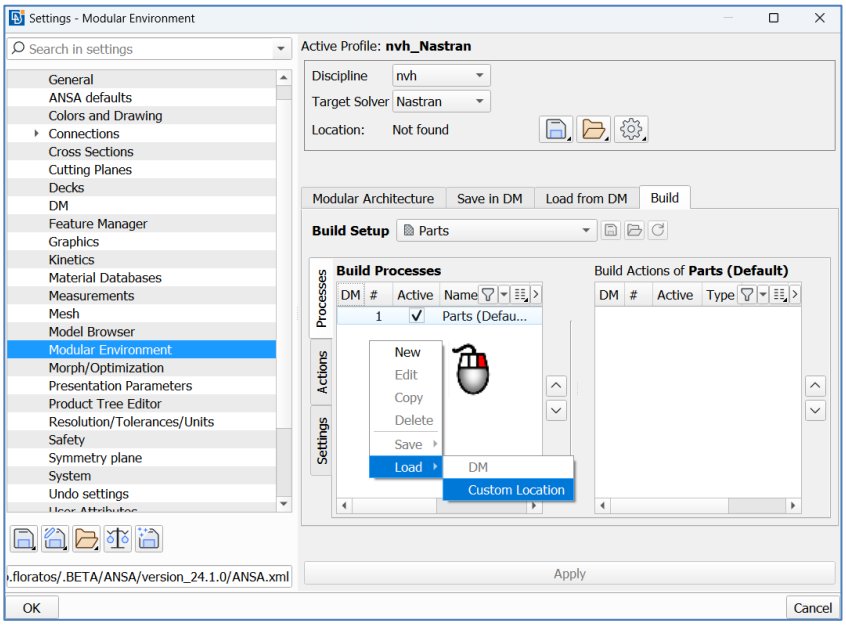
This table states and describes all the available *Treatments* that exist currently in the Part Build process.

Modeling Treatment	
Common	The ANSAPART is at an error free geometry state that is ready to be meshed.
Surface Mesh	The ANSAPART has been successfully meshed with 2D shell elements, where the mesh meets some specifications.
Volume Mesh	The ANSAPART has been successfully meshed with 3D tetra elements, where the mesh meets some specifications.
Casting	A 2D middle mesh has been created from the casting component, where the mesh meets some specifications.
Extrusion	A 2D middle mesh has been created from the extruded profile, where the mesh meets some specifications.

2.3. Load Part Build actions

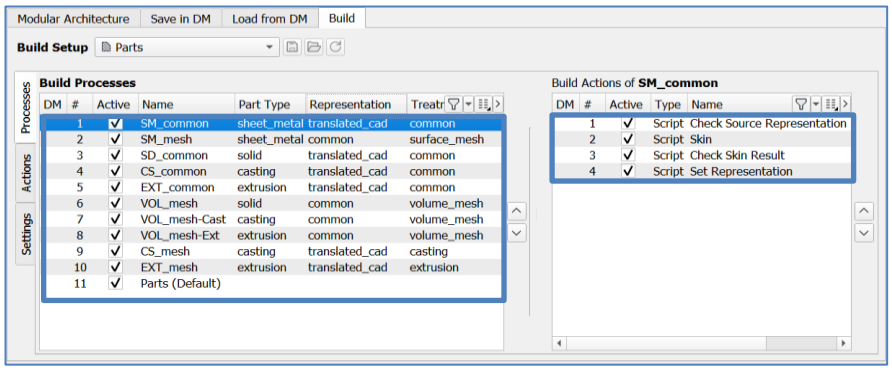
The Part Build process, as already mentioned, is driven by three ANSAPART attributes: *Representation*, *Part Type* and *Treatment*. This chapter describes how all the actions (build actions) that will take place for every combination of the *Representation*, *Part Type* and *Treatment* values are defined.

First, we will describe how the user can load the suggested Part Build process that exists inside the ANSA package. Open *Tools > Settings*, go to *Modular Environment* and then go to the tab *Build*.



Go to the *Build Processes* window and press **RMB > Load > Custom Location**. Now the user is prompt to select a ".json" file. Type "$ANSA_EXEC_DIR" and press "ENTER" to go directly to the installation directory of ANSA. Then follow the path "scripts > MBC Actions > Parts" and load the "part_build_processes.json" file. The suggested Part Build process is now loaded.

On the "Build Process" part of the window all the loaded build processes are listed. By selecting one of them the user can see the respective build actions of this specific build process on the "Build Actions" part of the window.

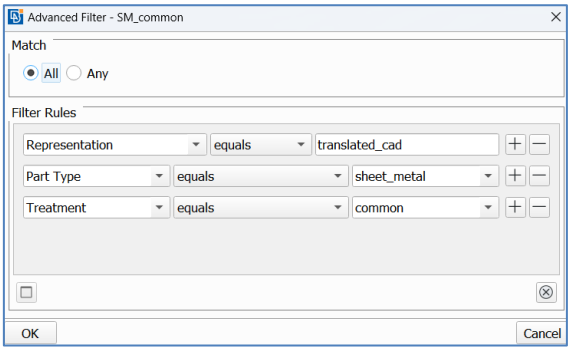


Build Process – Build Actions

Every build process corresponds to a combination (basically a filter) of the values of *Representation*, *Part Type* and *Treatment*. This means that the build actions of this build process will be automatically available to all ANSAPARTs that meet this filter. Double click on a build process to see the filter rules in detail.

For example, in the image on the right we see:

1. *Representation*: translated_cad
2. *Part Type*: sheet_metal
3. *Treatment*: common



Build Process filters

So, this process will be applied on sheet metal ANSAPARTs that have just been translated from CAD and will result in their common representation (an error free geometry ready to be meshed), if of course their respective attributes have been specified correctly. The four build actions that will run in this case are: **Check Source Representation**, **Skin**, **Check Skin Result** and **Set Representation** as seen in the image at the top of the page. Every build action is described in detail in chapter 2.4.

The suggested Part Build process that comes inside the ANSA package has specific steps (build processes) that can be applied to every part type.

Part Type	Representation	Treatment
sheet_metal, solid	translated_cad	common
sheet_metal, solid	common	surface_mesh, volume_mesh

Part Type	Representation	Treatment
casting, extrusion	translated_cad	common
casting, extrusion	common	casting, extrusion

The tables above show that before we mesh every Part Type, we should first reach its common *Representation*. For the *Part Types* sheet_metal and solid this is essential because a geometry error can cause a problem or even a failure to the meshing algorithms. However, for casting and extrusion this is not essential since the middle mesh creation algorithms of ANSA can work even if there are minor errors in the geometry. So, the suggested Part Build process gives also the possibility to the user to go directly from translated_cad to casting/extrusion *Representations*.

Part Type	Representation	Treatment
casting, extrusion	translated_cad	casting, extrusion

Finally, the users have also the possibility to tetra mesh on casting/extrusion components through the Part Build process if from their common *Representation* apply a volume_mesh *Treatment*.

Part Type	Representation	Treatment
casting, extrusion	common	volume_mesh

2.4. Build Process – Build Actions catalogue

In this chapter there is complete catalogue that describes the build actions of all the build processes.

Sheet Metal		
Build Process	**Build Actions**	**Description**
translated_cad -> common (SM_common)	Check Source Representation	Checks the validity of source representation (translated_cad).
	Skin	Applies Skin and creates the middle geometry of the ANSAPART.
	Check Skin Result	Checks the validity of Skin's result.
	Set Representation	Sets the *Representation* of the ANSAPART to common.

Sheet Metal		
Build Process	**Build Actions**	**Description**
common -> surface_mesh (SM_mesh)	Check Source Representation	Checks the validity of source representation (common).
	Meshing	Runs a 2D shell Batch Mesh scenario.
	Check mesh result	Checks the result of Batch Mesh scenario for quality criteria violations.
	Set Representation	Sets the *Representation* of the ANSAPART to surface_mesh.

Solid, Casting, Extrusion		
Build Process	**Build Actions**	**Description**
translated_cad -> common (SD_common), translated_cad -> common (CS_common), translated_cad -> common (EXT_common)	Check Source Representation	Checks the validity of source representation (translated_cad).
	Geometry Checks	Checks and tries to fix geometry errors.
	Set Representation	Sets the *Representation* of the ANSAPART to common.

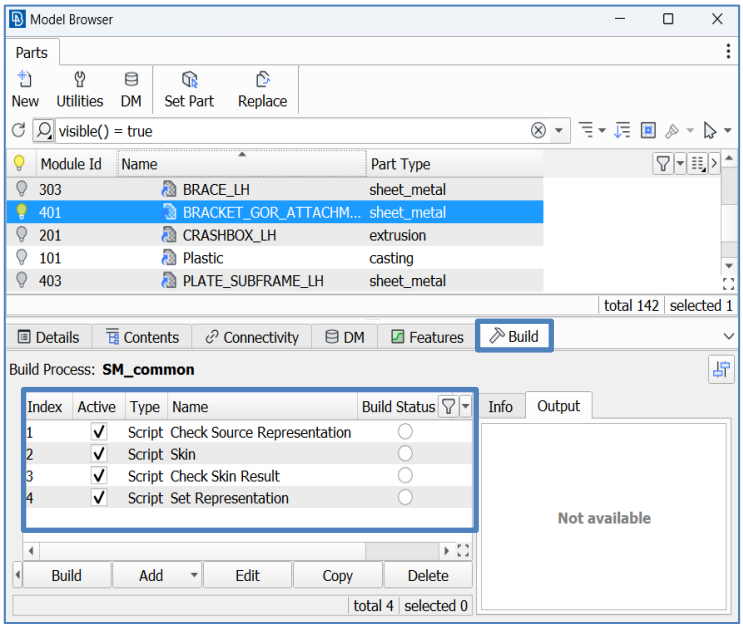
Solid, Casting, Extrusion		
Build Process	**Build Actions**	**Description**
common -> volume_mesh (VOL_mesh), common -> volume_mesh (VOL_mesh-CAST), common -> volume_mesh (VOL_mesh-EXT),	Check Source Representation	Checks the validity of source representation (common).
	Surface Meshing	Runs a 2D shell Batch Mesh scenario.
	Check surface mesh result	Checks the result of Batch Mesh scenario for quality criteria violations.
	Volume meshing	Runs a 3D solid structural Batch Mesh scenario.
	Check volume mesh result	Checks the result of the volume Batch Mesh scenario for quality criteria violations.
	Set Representation	Sets the *Representation* of the ANSAPART to volume_mesh.

Casting, Extrusion		
Build Process	**Build Actions**	**Description**
translated_cad -> casting (CS_mesh), translated_cad -> casting (EXT_mesh)	Check Source Representation	Checks the validity of source representation (translated_cad).
	Casting/Extrusion	Runs Casting or Extrusion algorithm to the ANSAPART.
	Check mesh result	Checks the result of Casting/Extrusion for quality criteria violations. ! The global quality criteria will be used for this check.
	Set Representation	Sets the *Representation* of the ANSAPART to casting/extrusion.

3. Apply Build and RLIs

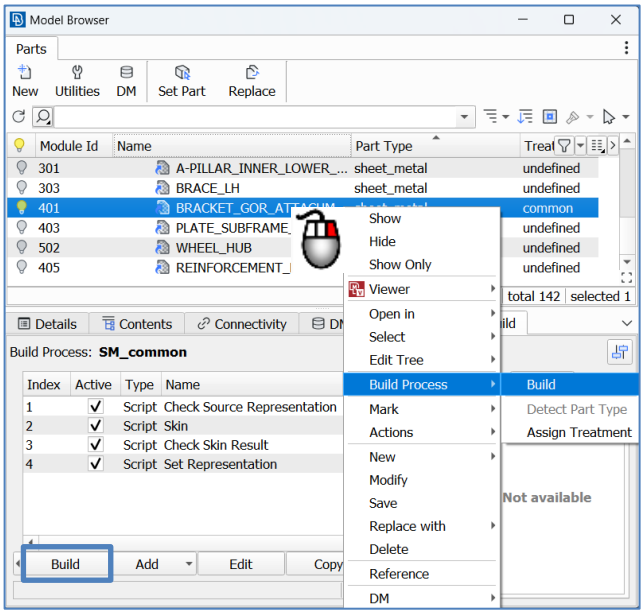
3.1. Apply Build Actions

As long an ANSAPART fulfills the filters of a build process, the respective build actions will be available in the *Build* tab of Model Browser.

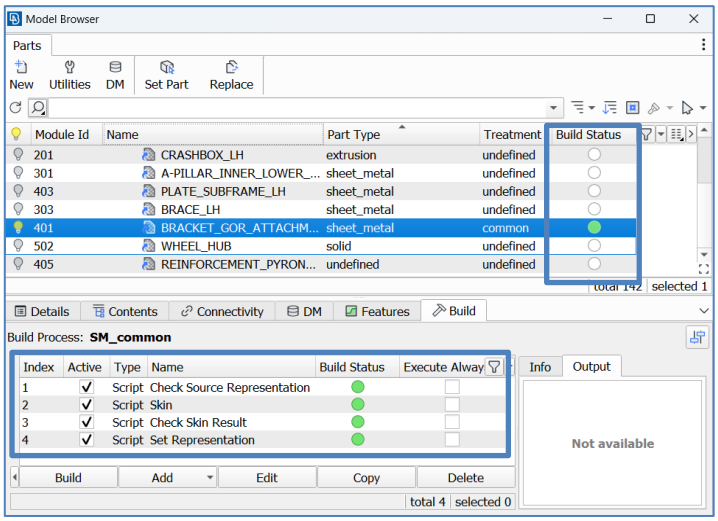


There are two ways to execute the part build actions. The first one, which is also the recommended, is to execute them all at once (left image). This means that every build action will be executed automatically one after the other until all the build actions have been completed successfully. Go to the ANSAPART and use **RMB > Build Process > Build** or use the **Build** button in the bottom left of *Build* tab without any build actions selected.

Also, the user can execute one build action at a time (right image). After the selected action is executed, the user should go and execute the next one. This is a more time-consuming way to execute the build actions, but it may be used if the user needs to inspect the model every time an action is completed.

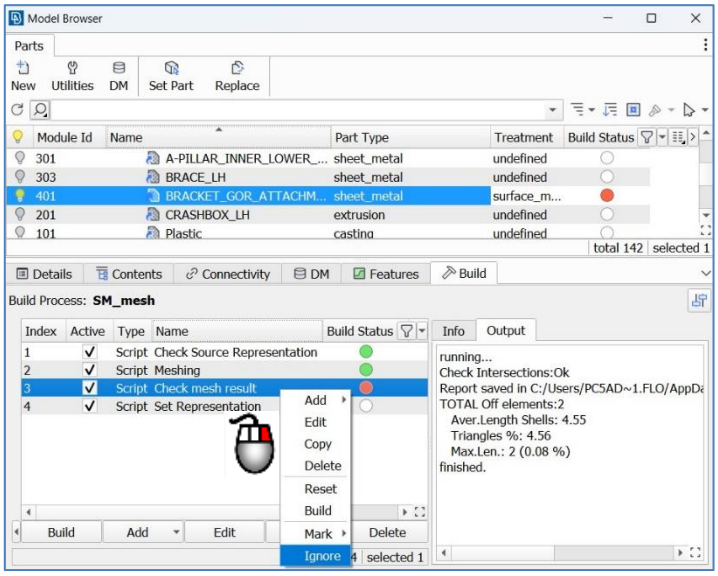


When the build actions are executed successfully their *Build Status* will turn green. If all the build actions have been executed successfully the parent *Build Status* of the ANSAPART will also turn green.



In case that a build action fails, its status will become red. This means that the actions could not be executed successfully, the build process stops, and the user needs to inspect the model and fix the problem.

In some cases, most likely for build actions that corresponds to checks (where the failure can be a violation of some quality criteria in one-two elements), the user can choose to continue the build process even if the action failed. This can be done with **RMB > Ignore**.

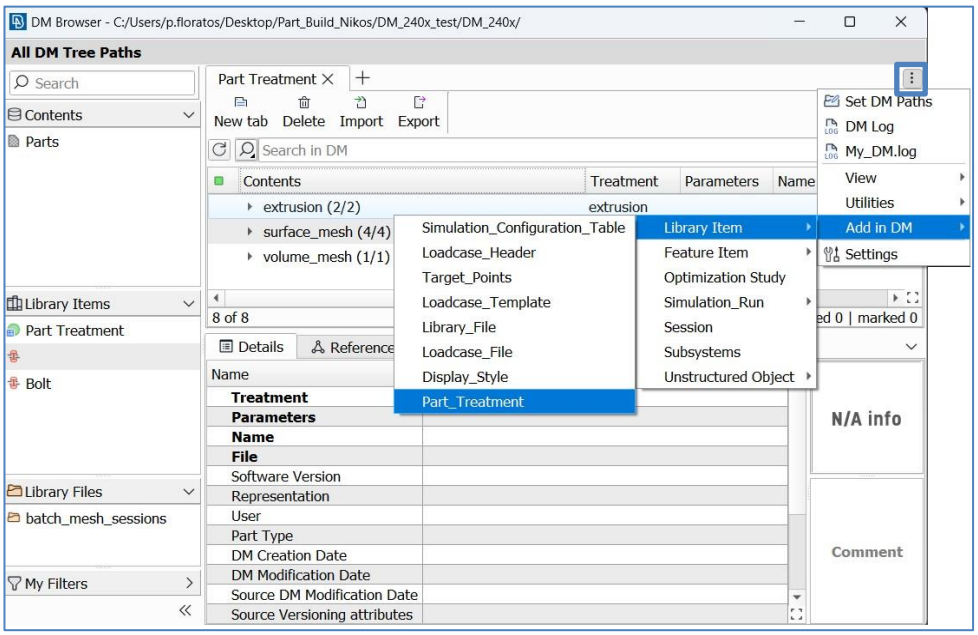


3.2. Part Treatment – Rich Library items

This chapter will describe the use of Rich Library items (RLIs) in the Part Build process. Some of the build actions mentioned above apply mesh on the ANSAPARTs. This can either be surface mesh algorithms, volume mesh algorithms or algorithms that create the middle mesh of ANSAPARTs. This raises the need for mechanism that will enable the user to define the mesh parameters and the quality criteria of these build actions.

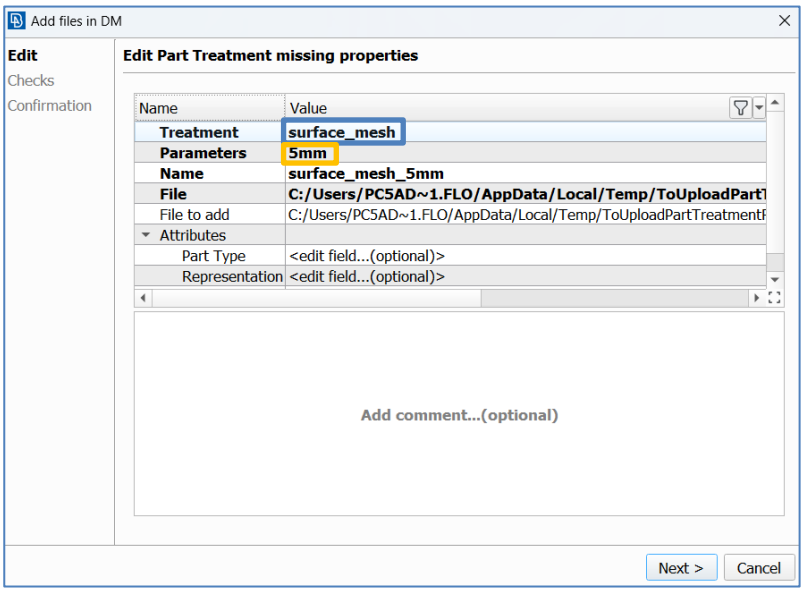
This need is covered with RLIs, which are library items that can be saved inside the ANSA DM. These items are files that are stored inside the ANSA DM and the build actions can access them and use them accordingly. For the *Part Types* sheet_metal and solid these items are ANSA dbs that contain the batch mesh scenarios that will run on these ANSAPARTs. For the *Part Types* casting and extrusion the case is different as the respective middle mesh creation algorithms need only some specific values as input e.g. *target element length*, *collapse perimeters distance* etc. For these cases ANSA defaults (.defaults) files are used that contain only the keywords that correspond to the execution parameters of casting/extrusion algorithm.

In order to save an RLI to the DM the user needs to open *DM Browser* go to Main menu (three dots on the top right of the screen), select **Add in DM > Library Item > Part_Treatment** and then specify the path to the library file that will be saved in the dm (ANSA db with batch mesh scenario(s) or ANSA.defaults file with casting/extrusion parameters).



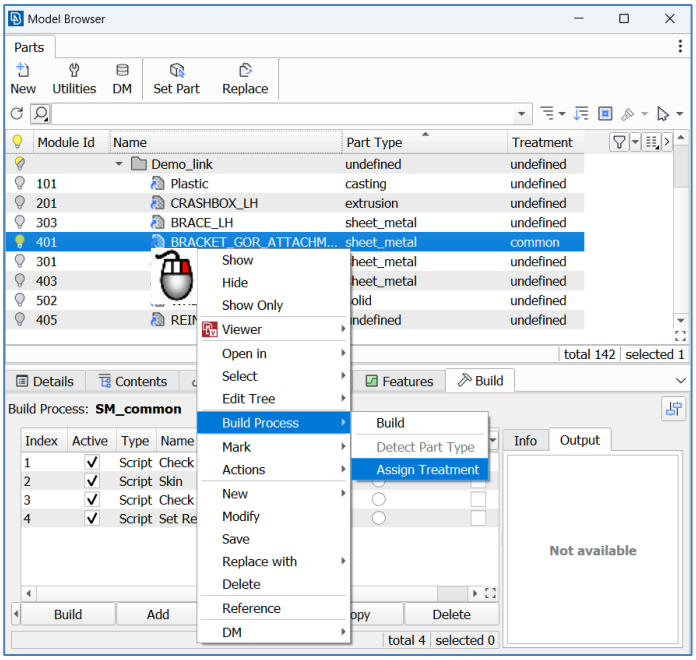
In the *Add files in DM* window the user needs to specify the fields “Treatment” and the “Parameters”. The “Treatment” specifies for which *Treatment* this RLI will be used e.g. surface_mesh. The valid treatments that can be used are surface_mesh, volume_mesh, casting, extrusion.

The field “Parameters” should be used to denote some useful information about each specific RLI since the user can have more than one RLI saved for each *Treatment* e.g. surface_mesh_5mm, surface_mesh_7mm etc.

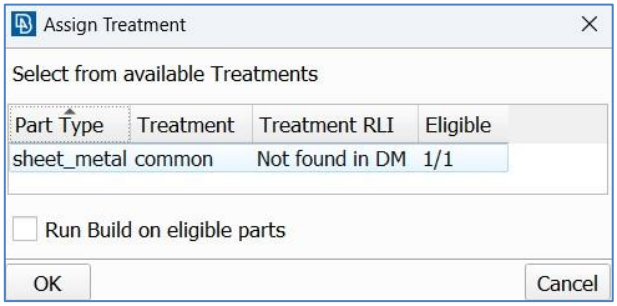


3.3. Assign Treatment

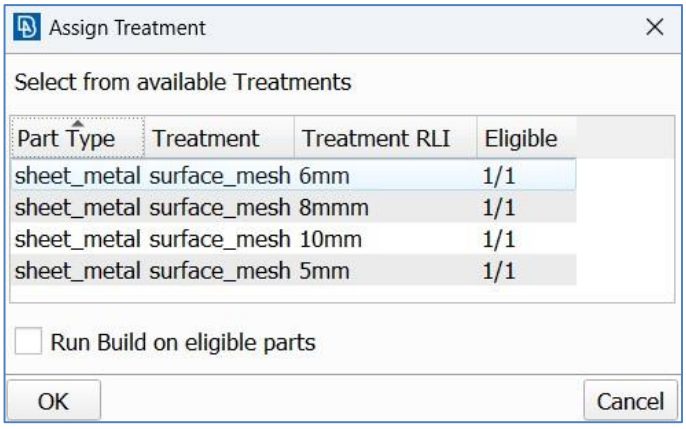
The user can go and manually define the *Treatment* of the ANSAPARTs through Model Browser. Alternatively, the user can press RMB on the ANSAPART and use **Build Process > Assign Treatment**. This function will prompt the user to select one amongst all the available treatments that can be used on this specific ANSAPART based on its current *Representation* and *Part Type*.



Sheet metal: translated_cad -> common



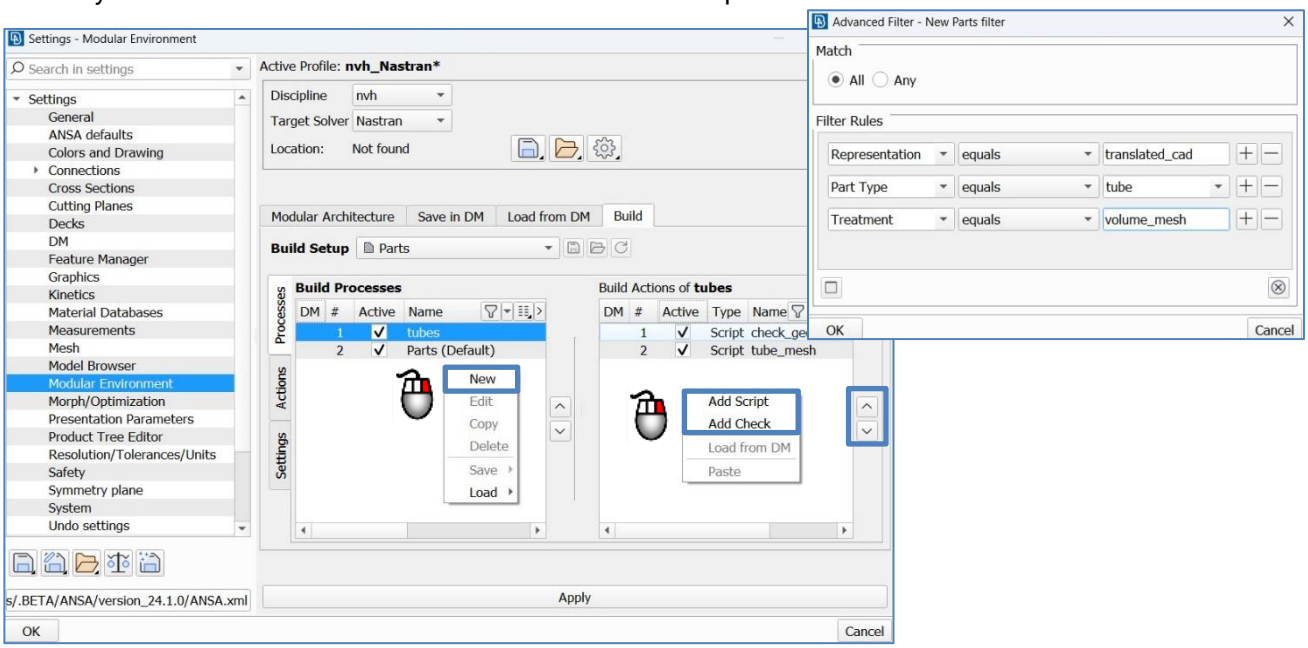
Sheet metal: common -> surface_mesh



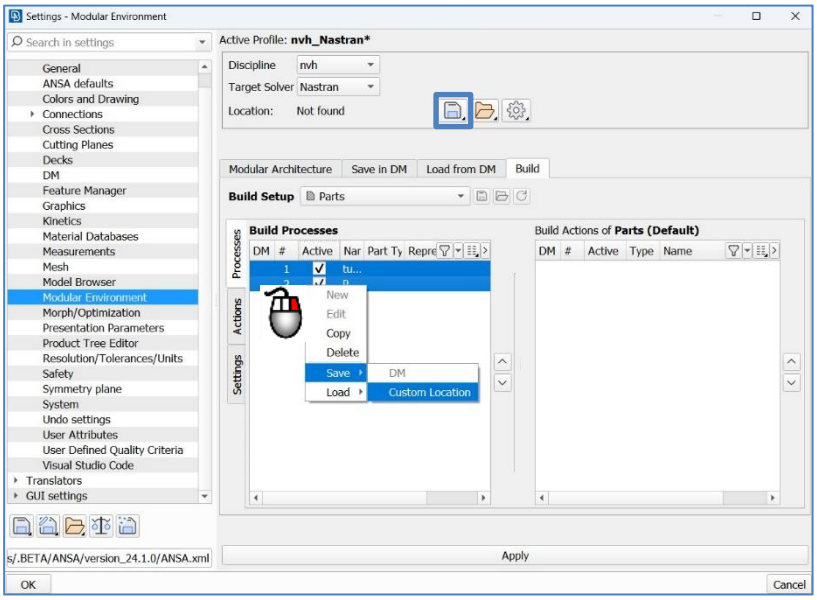
3.4. Create a Custom Build Process

This chapter describes how users can create their own build processes. Open *Tools > Settings*, go to *Modular Environment* and then go to the tab *Build*. Use RMB on the *Build Process* part of the window and select **NEW** to create a new build process. Double click on the build process, the *Advanced Filter* window opens. In this window the user can specify the filter rules that define for which ANSAPARTs this process will be available based on their attributes.

Select a build process and go to the *Build Actions* part of the window. Press RMB to create a build action. Build actions can be either a user script or a check. With the arrows on the right part window the user can change the series by which the build actions will be executed in the build process.



Select all the created build processes and use **RMB > Save** to save them either in the DM or in a custom location. Also, the save icon can be used to save the whole modular environment profile, including the part build processes.



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