



Volkswagen AG Increase Agility and Collaboration in Engineering Development Using MSC Nastran Modules

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As we all know in the finite element world, traditional FEA model build-up contains multiple parts and sub-structures which are then organized in finite element codes (such as 'include' files in MSC Nastran) for easy exchangeability. While using these include files, a strict numbering guideline needs to be followed to avoid ID collisions between INCLUDEs.

It is required in MSC Nastran that a complete model is built-up without overlapping of ID's. This sort of build provides independent INCLUDE files to handle which are easy to reuse and interchange whenever the vehicle design changes. However, with this method, it is hard to manage these files as the users must follow an elaborate numbering scheme. This method needs high discipline, monitoring effort as well because it needs to be adapted regularly due to new requirements.

Volkswagen has enjoyed a long-standing relationship with MSC Software for many years. Volkswagen not only uses the advanced technologies from MSC Software for their analyses, they also drive the requirements for the new developments in MSC Nastran. One of the most recent developments is "Modules" in MSC Nastran. As computational resources are becoming cheaper, models are getting larger. These larger models require efficient model management. With this new technology called "Modules" in MSC Nastran, whose development was driven by Volkswagen, the model management now becomes very accessible.

Modules are introduced in MSC Nastran as an assembly management tool; it is a standalone Bulk Data section that typically contains a part or component of an overall assembly. Modules are analogous to part super elements without reduction. MSC Nastran can also create multiple instances of a primary MODULE with a process referred to as MODULES Instantiation.

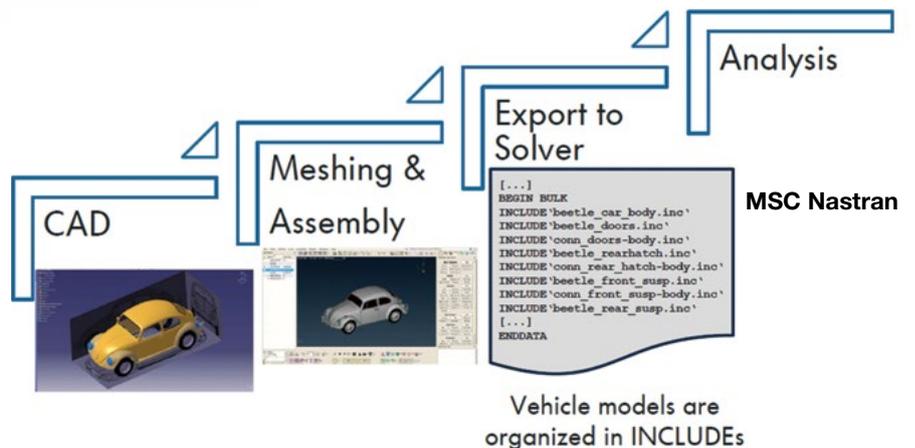


Figure 1: Traditional Model Build Up

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- Dr. Bruns, Volkswagen

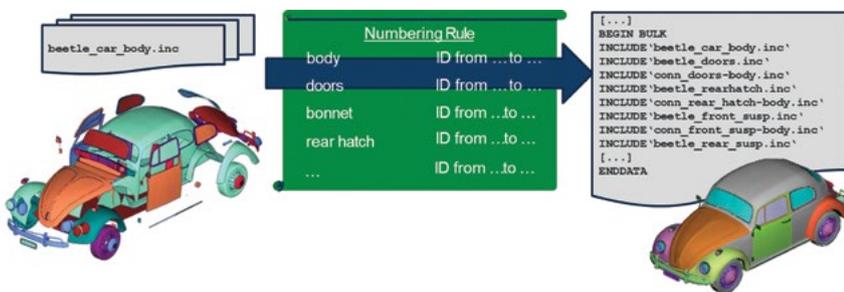


Figure 2: Model Build up at Volkswagen

The key benefits of modules are that they reduce reliance on a pre-processor for creating copies of, translating, rotating, or mirroring an existing primary MODULE – this also helps reduce modeling time. Additionally, MSC Nastran’s MODULE uses similar definitions as some other codes – this allows for quick translating of a MSC Nastran BDF for other simulations such as crash simulation with PAM-CRASH.

Now, there is also a need to connect these different modules, for which manual, automatic and semi-automatic methods are available for connecting modules.

Each module has its own ID numbering scheme for grid points, elements, properties and so on. The ID numbers do not have to be unique across Modules.

“The modules approach helps us save time and ensure our high-quality results. We can use the decrease effort in model build-up, exchange, as well as pre-post processing for NVH, Durability, and Nonlinear Analysis,” says Dr. Bruns from Volkswagen.

A module is a standalone Bulk Data section that typically represents a component of an overall assembly, e.g., an automobile wheel or fender. Modules allow the users to assemble multiple Bulk Data sections to form a single MSC Nastran input file. Each module is delimited by the BEGIN MODULE and END MODULE Bulk Data entries.

Just like in part super elements, each module may have its ID numbering scheme for grids, elements, properties, and the ID numbers do not have to be unique across

modules. Post-processing results are available in the HDF5, F06, punch, and op2 files, which are partitioned by module.

So, to conclude, MSC Nastran Modules have the same characteristics as INCLUDEs, but without any ID collisions. Modules reduce the “numbering” work in the model assembly processes. Modules enable the automotive OEMs to easily exchange the models with other analysis groups (such as statics, crash, NVH). Finally, users can use switch variants easily to try out different designs in the vehicle development.

```

BEGIN BULK
Module 0 entries
BEGIN MODULE=10 label=...
Module 10 entries
END MODULE
Module 0 entries continued
BEGIN MODULE=20 label=...
Module 20 entries
END MODULE
BEGIN MODULE=30 label=...
Module 30 entries
END MODULE
Module 0 entries continued
BEGIN MODULE=40 label=...
Module 40 entries
END MODULE
ENDDATA
  
```

Figure 3: MSC Nastran Module Overall Bulk Data Section