Future Model-build-up process in ANSA using MODULEs

8th BEFORE REALITY CONFERENCE
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Volkswagen

Agenda

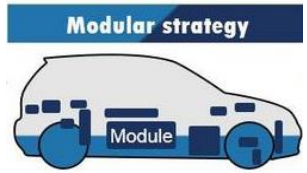
1 From the platform to the module strategy

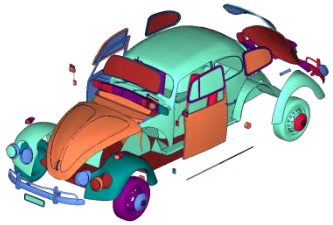
2 Current model-build-up process
- Process
- INCLUDE-structure and numbering rules
- Impacts on numbering rules

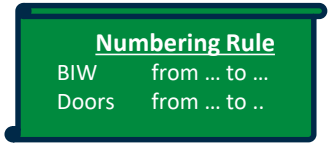
3 The concept of MODULEs
- Basic principle
- Content
- Hierarchy
- Connections between MODULEs

4 MODULEs in ANSA
- Definition
- Export to solver

5 Conclusion and outlook







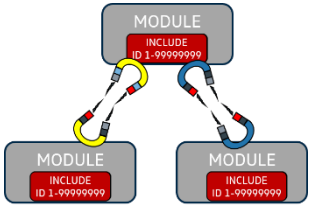


image source: Volkswagen AG, BETA CAE

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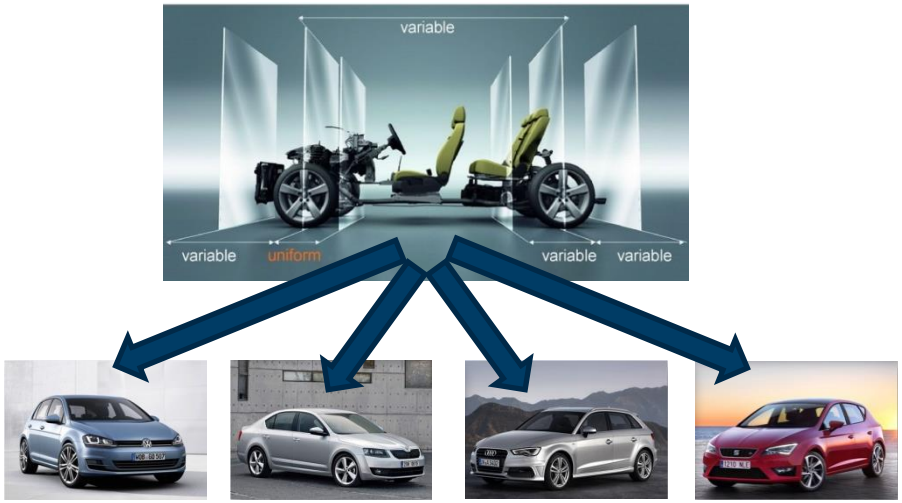
From the platform to the module strategy

Current strategy: Modular Platform Strategy
Building different vehicles on the same platform



Future: evolving to the toolkit strategy

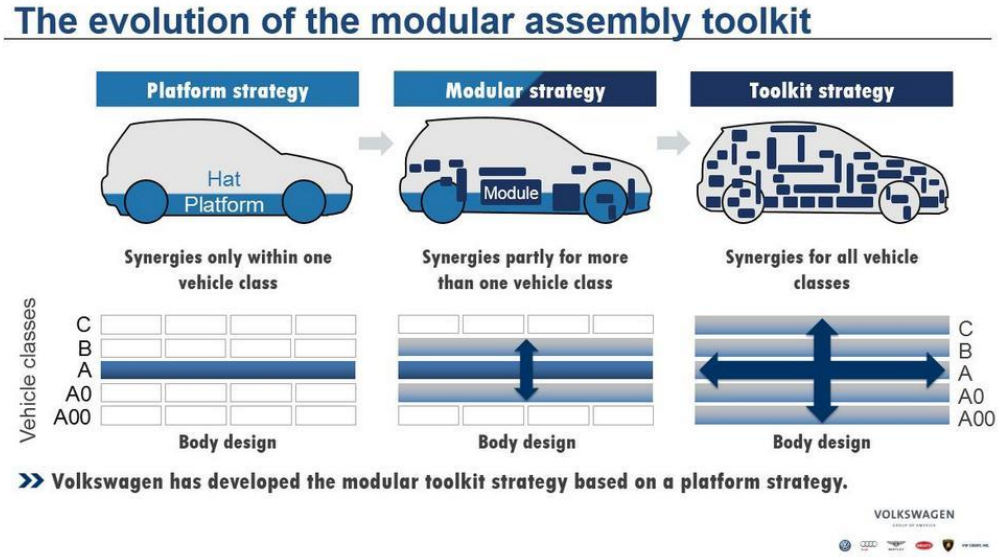


image source: Volkswagen AG

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Impacts on model build-up

From the assembly strategy:

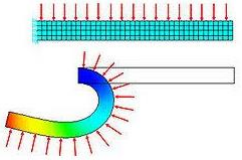
- The (re)-use of parts and sub-structures will increase.
- Number of derivates and variants will increase.

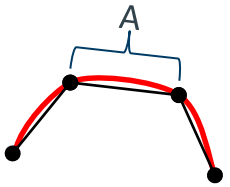
From the market/legislative authorities/consumer organisations:

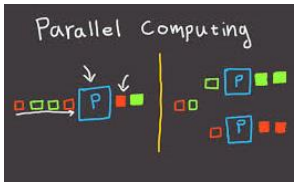
- Higher requirements on safety, comfort, noise,…
- New drive concepts (hybrid, electric, …)
- New mobility concepts (automated driving, urban traffic concepts,..)

Requirements on virtual vehicle models:

- More physical effects
- More geometrical details
- A more efficient and reliable model build up.
- More parallel and shorter analysis







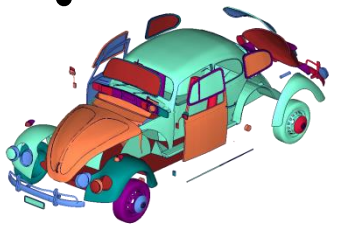


image source: Volkswagen AG, youtube.com, Euro NCAP, NHTSA, ADAC

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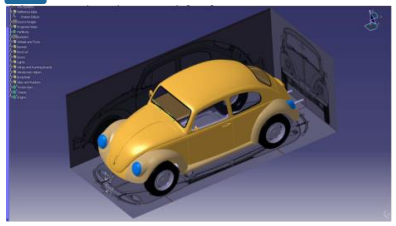
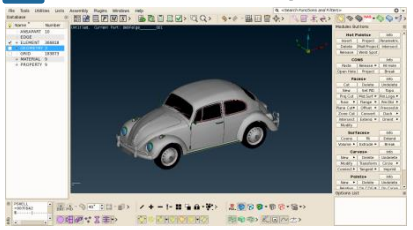
The model build-up process

Parts and sub-structures are organized in INCLUDES for easy exchangeability
A numbering guideline is needed to avoid ID collisions between INCLUDEs

CAD



Meshing & Assembly



Export to Solver

```
[...]
INCLUDE'beetle_car_body.inc'
INCLUDE'beetle_doors.inc'
INCLUDE'conn_doors-body.inc'
INCLUDE'beetle_rearhatch.inc'
INCLUDE'conn_rear_hatch-body.inc'
INCLUDE'beetle_front_susp.inc'
INCLUDE'conn_front_susp-body.inc'
INCLUDE'beetle_rear_susp.inc'
[...]
```

Vehicle model is split into submodels, which are organized in INCLUDES

Analysis

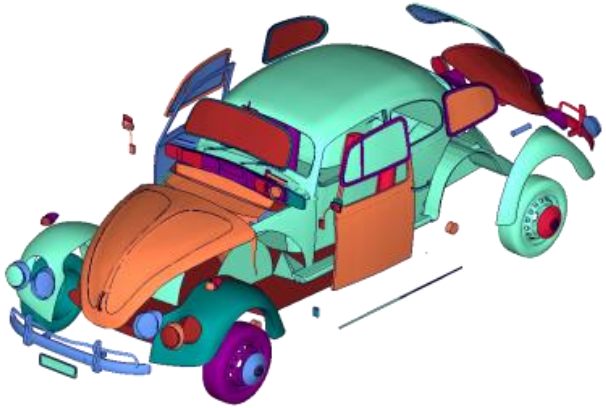
- NASTRAN
- Pamcrash
- ABAQUS
- …

image source: Volkswagen AG

Current INCLUDE structure

Required: A complete model without overlapping IDs

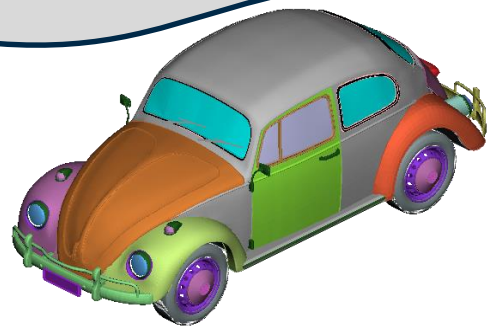
beetle_car_body.inc



Numbering Rule

body	ID from … to …
doors	ID from … to …
bonnet	ID from … to …
rear hatch	ID from … to …
…	ID from … to …

```
[...]
INCLUDE 'beetle_car_body.inc'
INCLUDE 'beetle_doors.inc'
INCLUDE 'conn_doors-body.inc'
INCLUDE 'beetle_rearhatch.inc'
INCLUDE 'conn_rear_hatch-body.inc'
INCLUDE 'beetle_front_susp.inc'
INCLUDE 'conn_front_susp-body.inc'
INCLUDE 'beetle_rear_susp.inc'
[...]
```



Advantages:

- Independent (parallel) INCLUDE handling.
- Interchangeability and resuseability.

Disadvantages:

- Complex, needs high discipline and monitoring.
- Needs to be adapted regularely due to new requirements.

image source: Volkswagen AG

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Impacts on the numbering rule

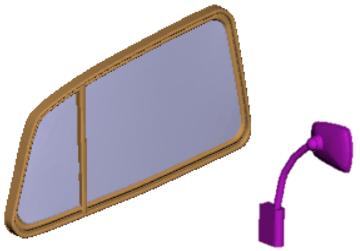
Practical example: front door

Fixed ID range from… to …

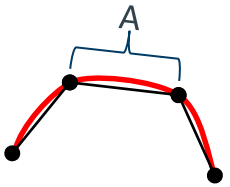
➔ Fixed number of entities

What to do if:

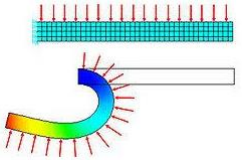
- New parts needs to be introduced?



- The edge length decreases?



- More entities are needed to integrate better physical behavior?



- ID range violation? ➔ Will cause problems for other disciplines
- Adapt numbering rule? ➔ Needs time for consultations
- Ignore the requirements? ➔ NO WAY!

image source: Volkswagen AG

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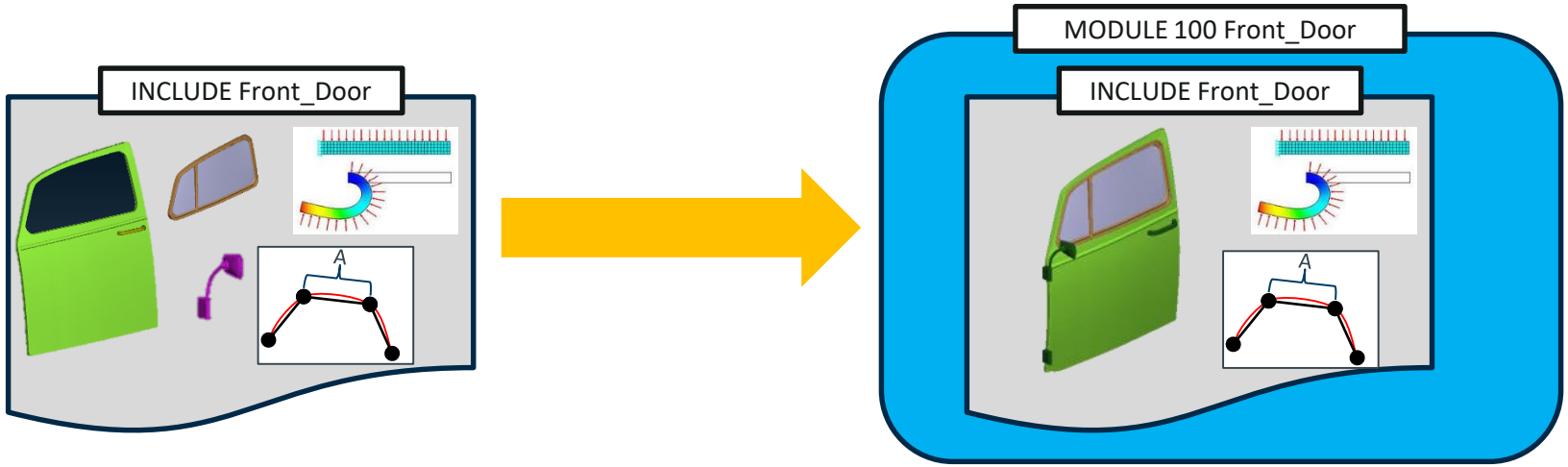
Introducing the concept of MODULEs: basic principle

Encapsulate the INCLUDE to create an independent numbering space



- INCLUDES are encapsulated to have the full ID range
  ➔ adding parts or decrease the edge length will cause no problems
- Each MODULE has a unique ID (> 0), but entity IDs must not be uniqe in the model
- Entity selection needs the MODULE ID as additional information

image source: Volkswagen AG

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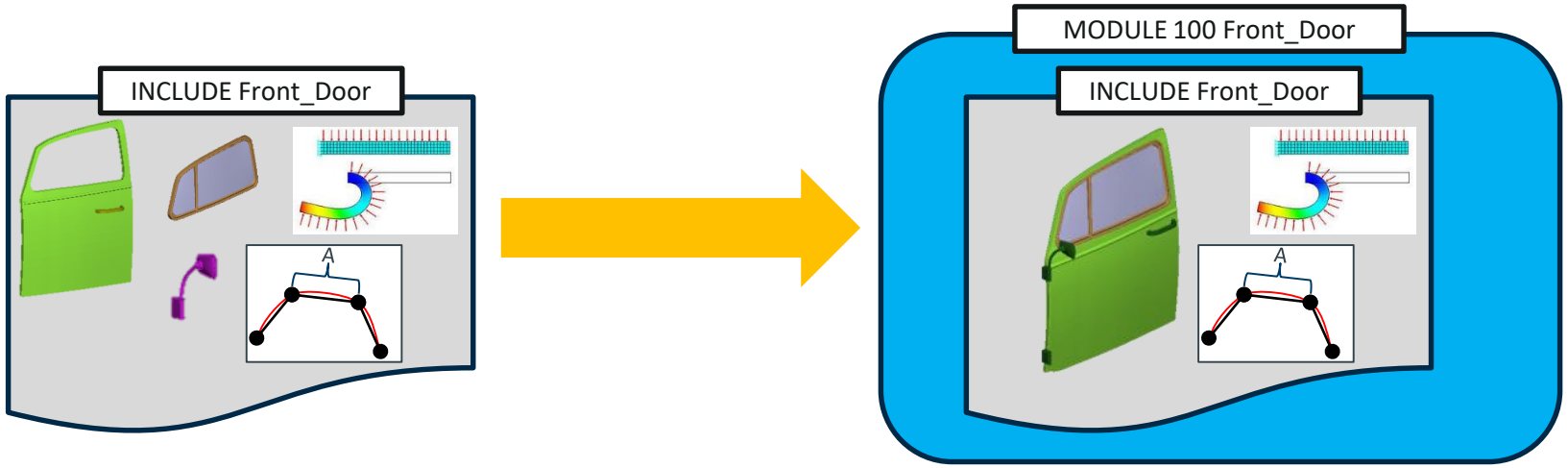
Introducing the concept of MODULEs: basic principle

Main differences between INCLUDEs and MODULEs



	INCLUDE	MODULE
Entity IDs	unique within the model	unique within the MODULE
Adressing Entities	by entity ID	by entity ID and MODULE ID
ID Range	according to numbering rule	independent from any other MODULE
Content	up to the user	must follow special rules

image source: Volkswagen AG

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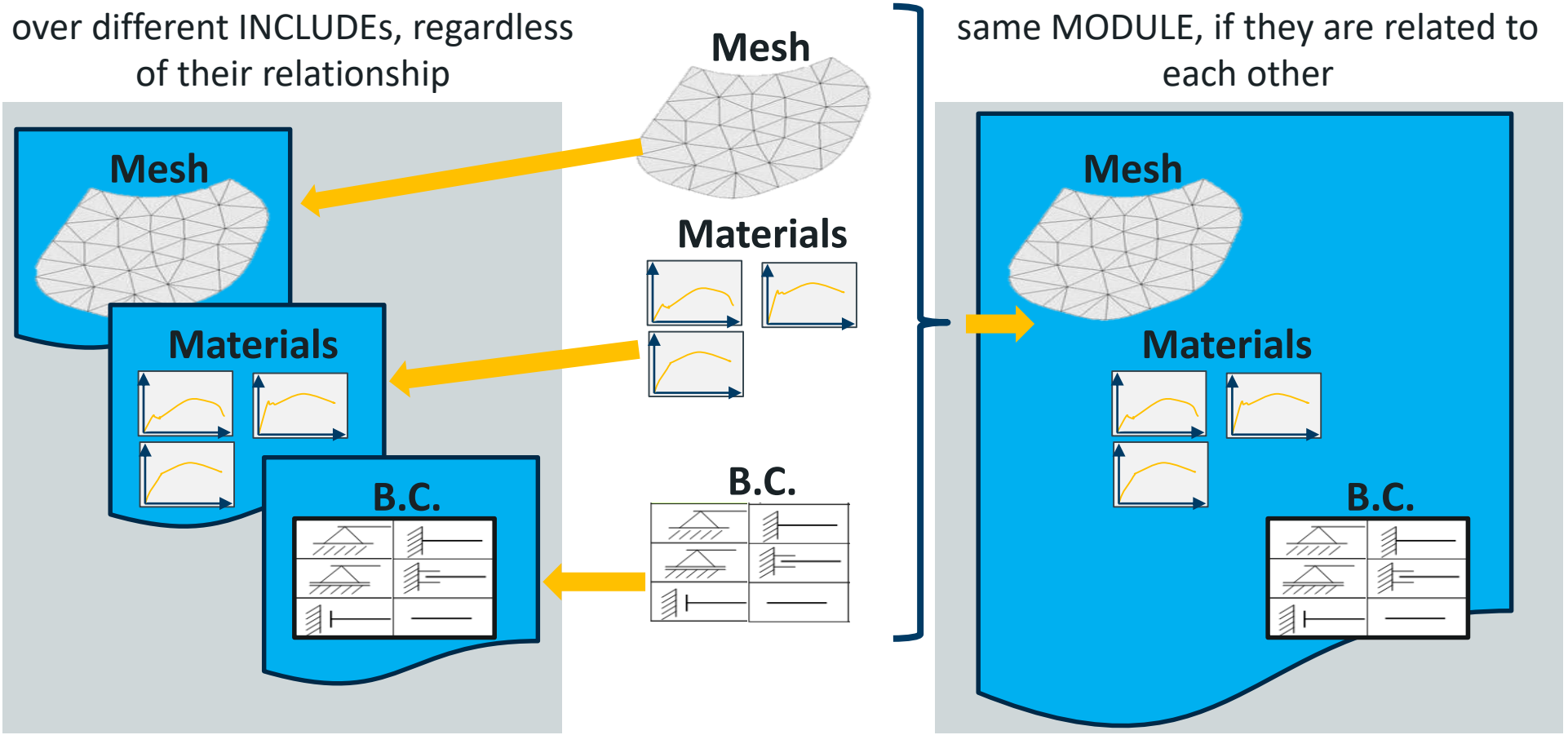
Introducing the concept of MODULEs: Content

INCLUDEs

All this information can be spread over different INCLUDEs, regardless of their relationship

MODULEs

All this information MUST be in the same MODULE, if they are related to each other



A MODULE must be an (potentially) valid submodel

image source: Volkswagen AG

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Introducing the concept of MODULEs: Hierarchy

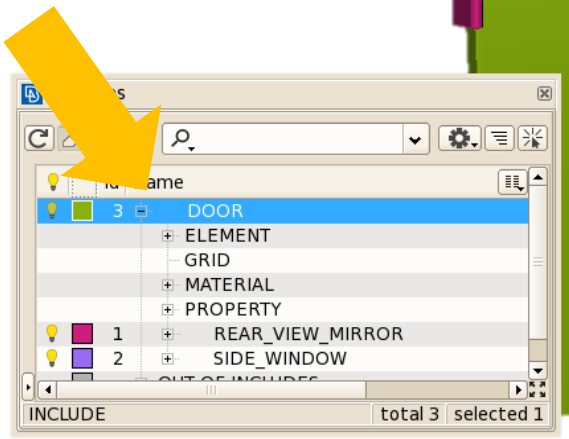
The use can define an INCLUDE hierarchy for easy variant handling

The same can be done with MODULEs*

*:MODULE hierarchy is not yet available in NASTRAN, but will be in future

INCLUDE Door
Nodes, Elementes, Properties,…

- INCLUDE Rear_View_Mirror
- INCLUDE Side_Window



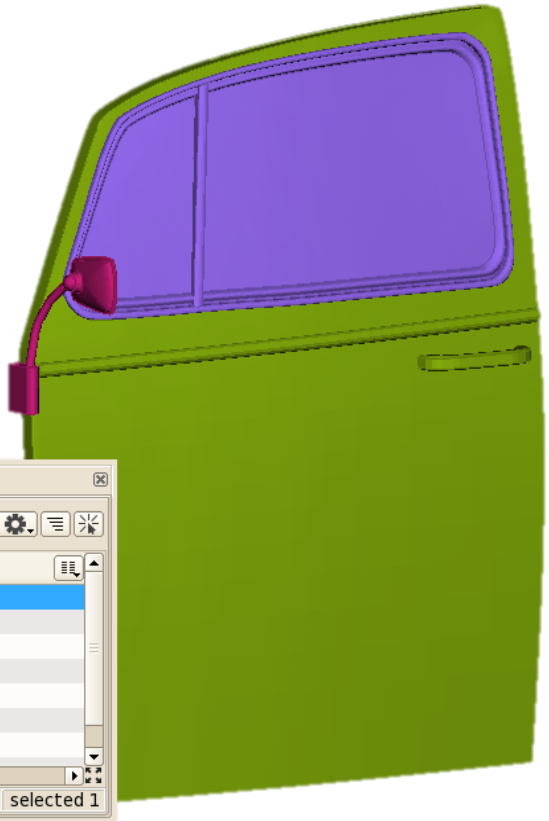


image source: Volkswagen AG

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Introducing the concept of MODULEs: Hierarchy

With INCLUDES the user is able to control the input stream for the solver, but after solving the model this information is lost, they are no real solver keywords.

MODULEs are real solver keywords for hierarchy definition, so the hierarchy is available in the solver results file, too.

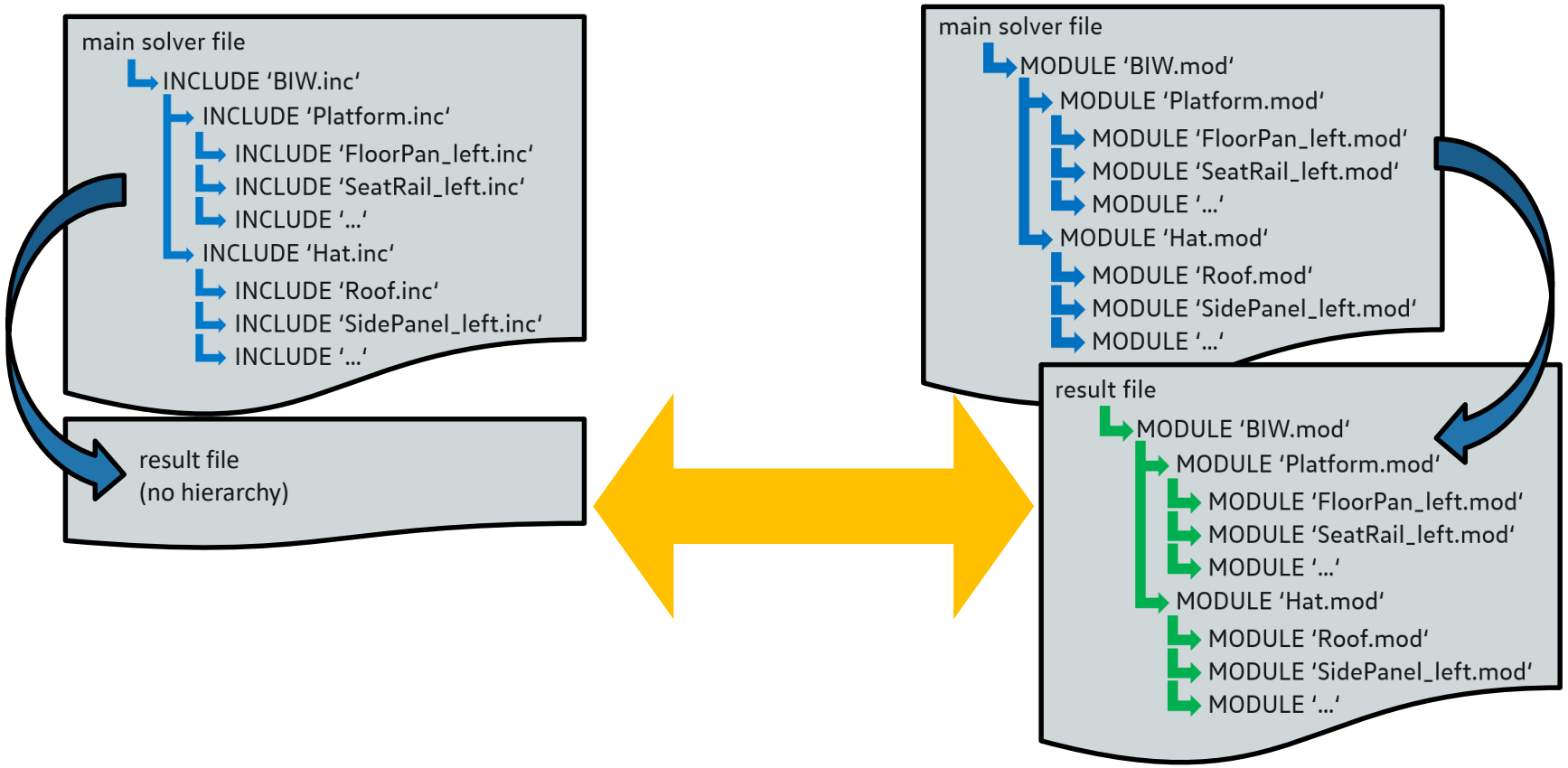

image source: Volkswagen AG

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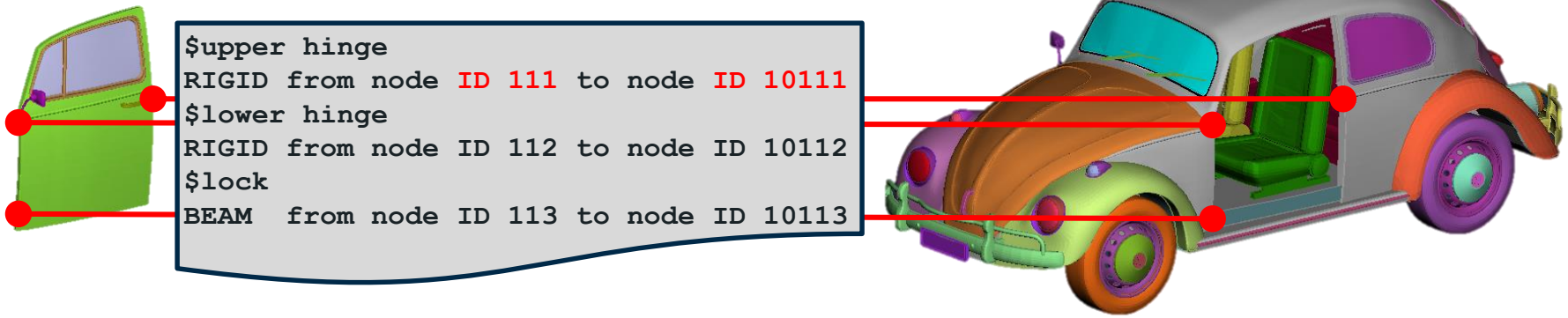
Connections between MODULEs

The connection definition between INCLUDEs is based on the numbering rule and the connection technique rules for the loadcase.



```
$upper hinge
RIGID from node ID 111 to node ID 10111
$lower hinge
RIGID from node ID 112 to node ID 10112
$lock
BEAM  from node ID 113 to node ID 10113
```

For MODULE connections more information must be provided:

The connected parts are addressed by their entity ID and their MODULE ID, but the connection technique is still the same

```
$upper hinge
RIGID from node ID 111 in MODULE 10 to node ID 111 in MODULE 1
$lower hinge
RIGID from node ID 112 in MODULE 10 to node ID 112 in MODULE 1
$lock
BEAM  from node ID 113 in MODULE 10 to node ID 113 in MODULE 1
```

image source: Volkswagen AG

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MODULEs in ANSA

Since Version 18.1.3 ANSA is able to support MODULEs

Coming from the idea, that MODULEs are „encapsulated INCLUDEs with special enhancements“, the MODULE definition and handling is located in the INCLUDE MANAGER of ANSA

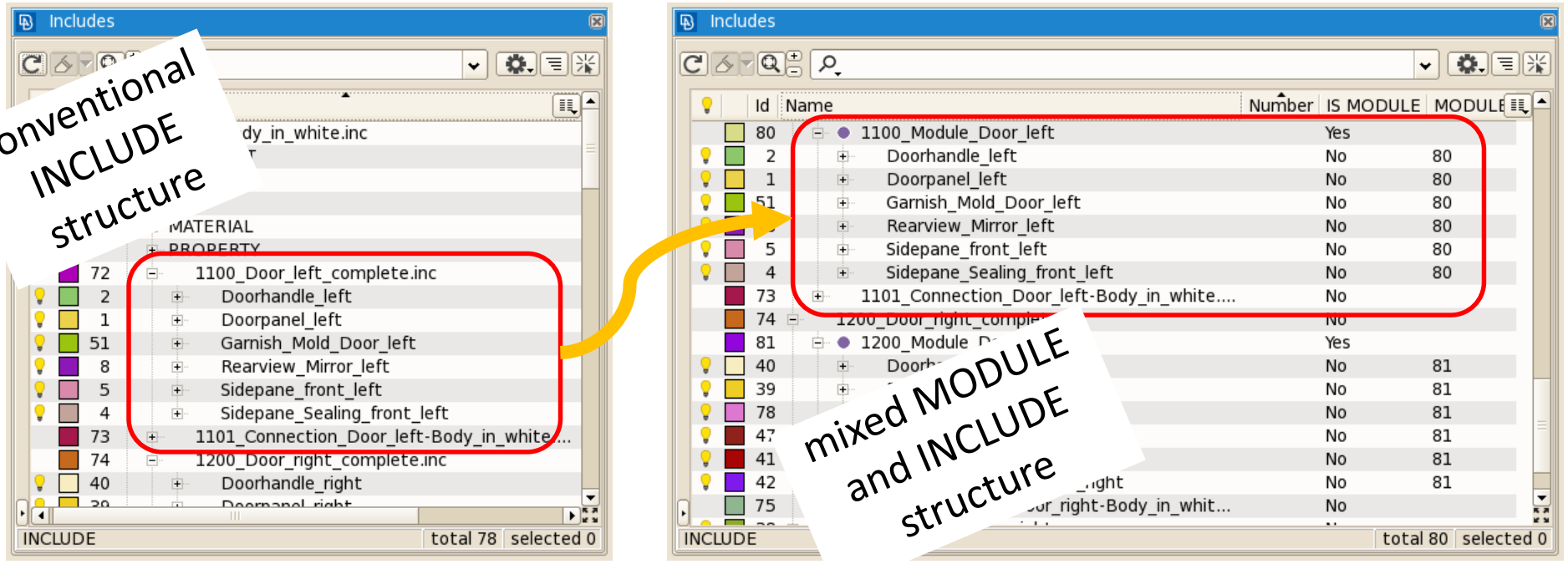

image source: Volkswagen AG

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MODULEs in ANSA

How to create a MODULE in ANSA?

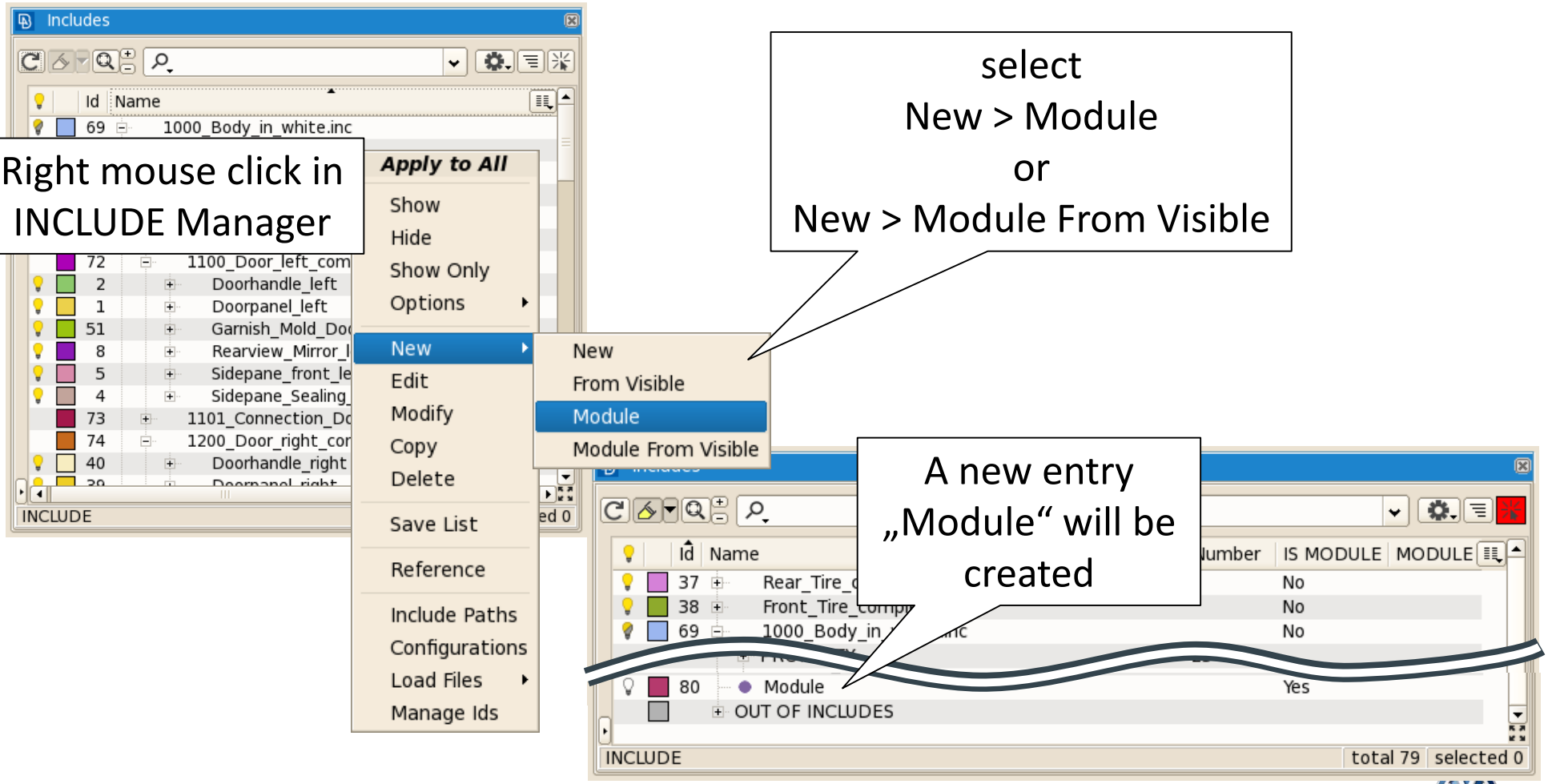

image source: Volkswagen AG

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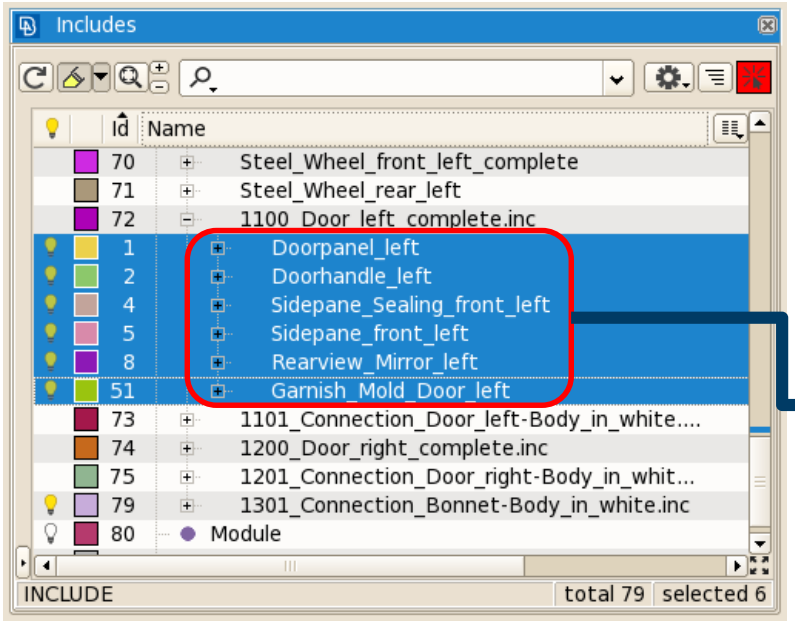
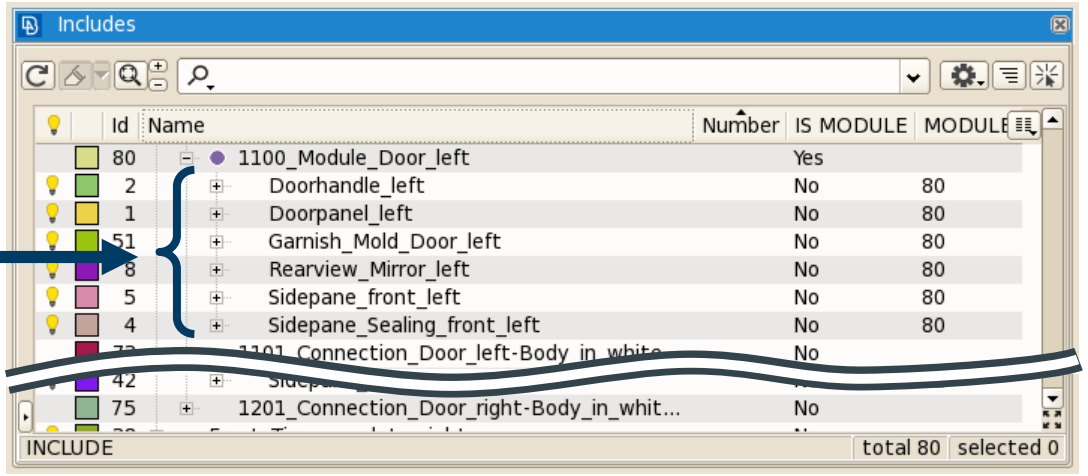
MODULEs in ANSA

Put content to the MODULE by drag & drop and rename the MODULE according to you needs



Make sure, that all related entities are moved to the MODULE, like nodes, elements, properties,…., by using subcontainer rules.



Materials have to be duplicated unless they are used only in the new MODULE.

Boundary conditions and some other entities have to be moved manually

image source: Volkswagen AG

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MODULEs in ANSA

When the model is written to the solver files, the MODULE statement is exported in the related INCLUDE.

Entities used to connect MODULE parts (MODULE connections) must be placed in MODULE 0 (NASTRAN requirement).

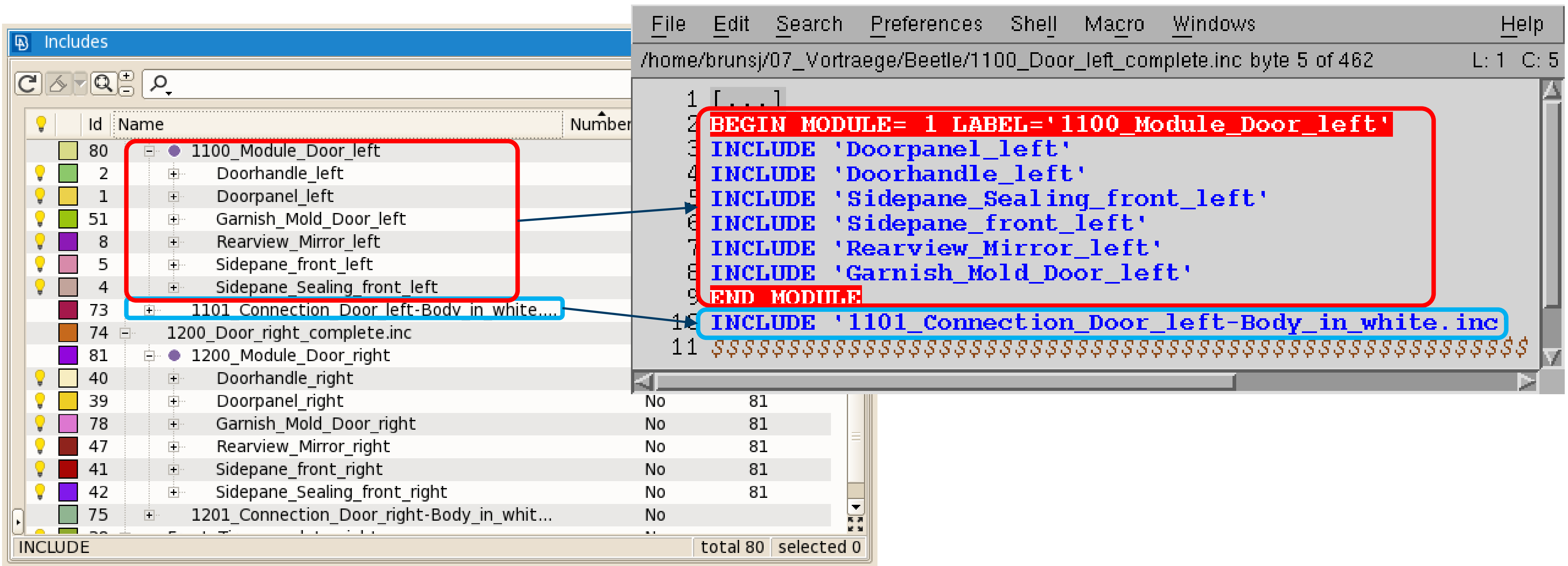

image source: Volkswagen AG

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Conclusion and outlook

- ANSA is able to im- and export NASTRAN and Pamcrash models with MODULEs
- ANSA can handle the possible ID overlapping
- MODULES can be created and re-arranged to fulfill the needed model structuring
- MODULE connections are created automatically if MODULEs are defined

Short term requests:

- Support of GLOBAL entries
- Enhancing the „subcontainer rules“ for easier MODULE definition
- Extra filters for MODULE connections needed
- New draw mode needed: MODULEs

Medium-term request:

- Supporting the multiple re-use of MODULEs (MODULE instantiation)

Many thanks for your attention!

image source: Volkswagen AG

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