



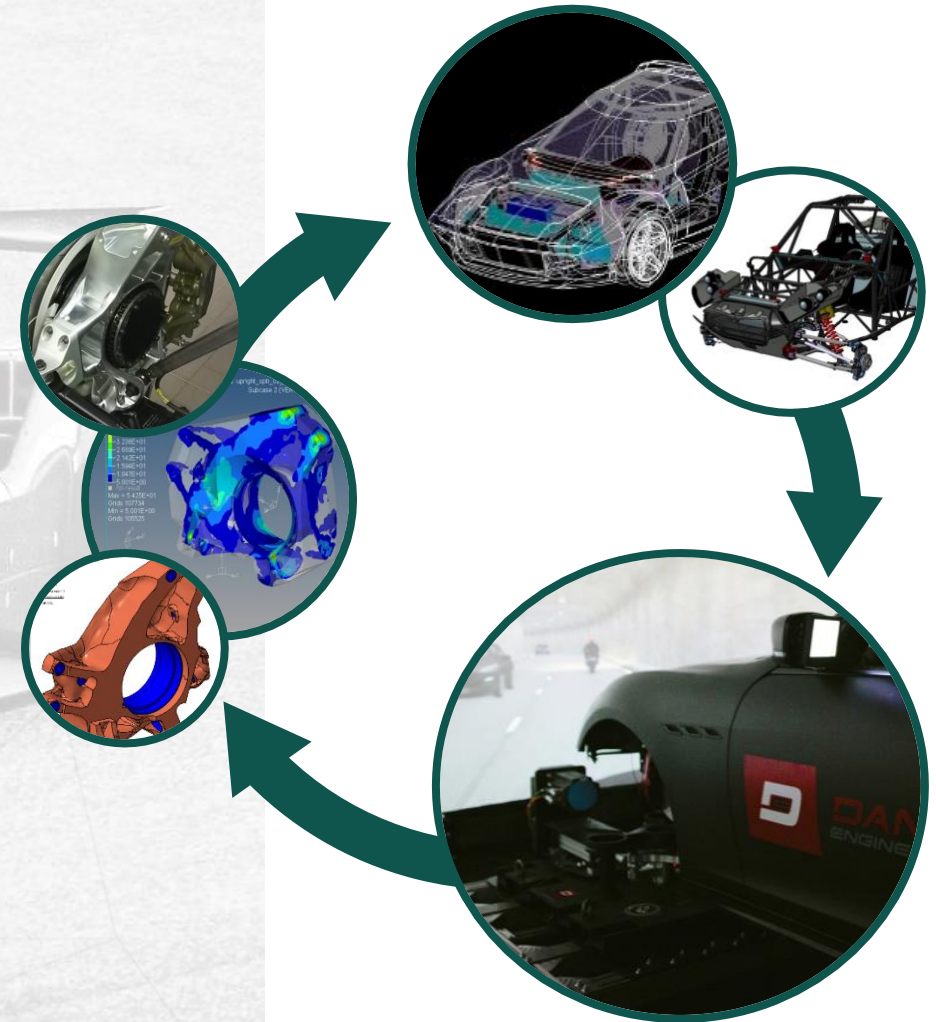
DANISI
ENGINEERING

25 YEARS
1995 - 2020

CHASSIS CASE STUDY

Engineered
Mules

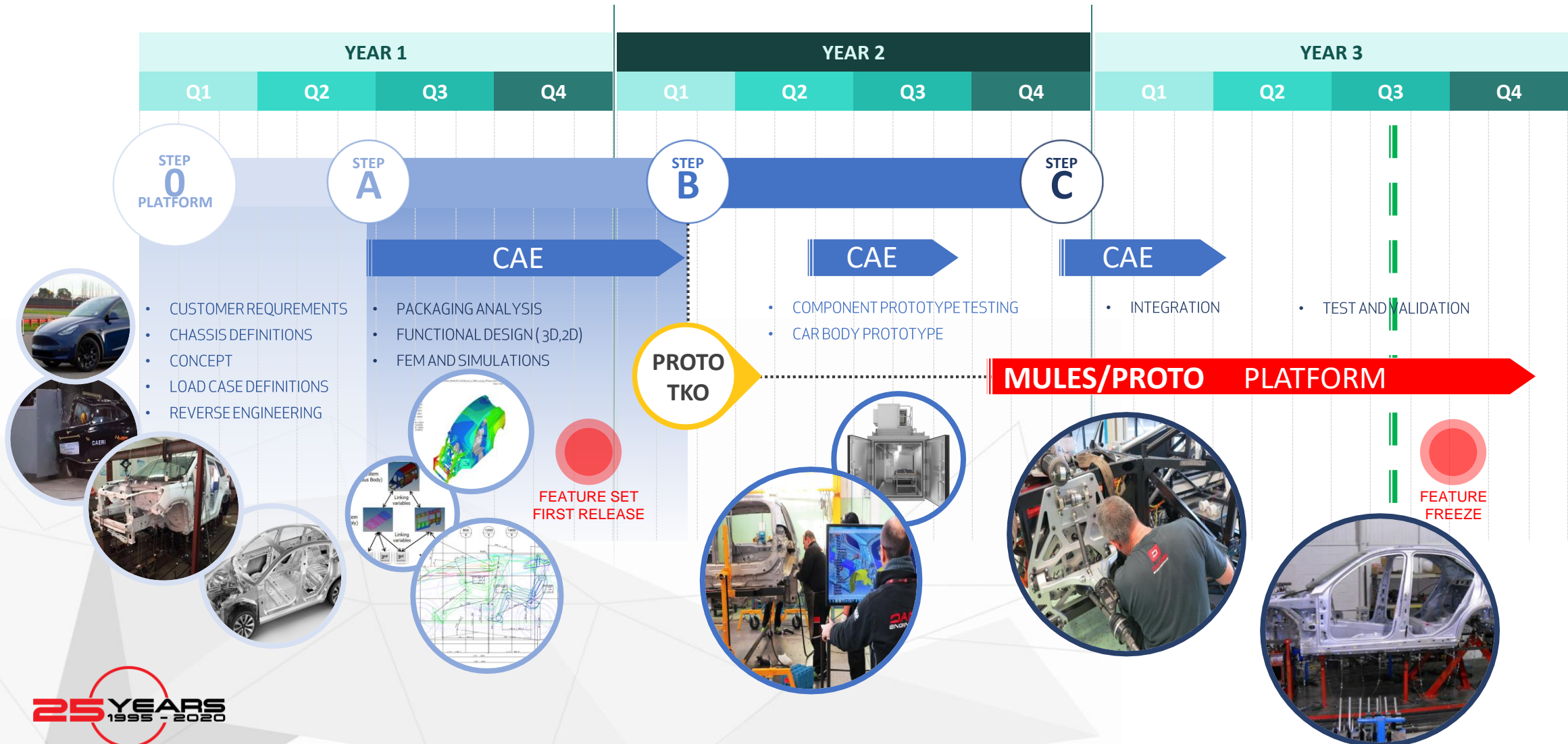
- CAD 3D for development of chassis components and assemblies (Catia, UG and SolidWorks skilled operators)
- Suspension engineering
- Body in White engineering
- Simulation
- Dynamic calculations
- FEM validation
- Optimization
- Packaging and installation design of powertrain, suspensions, steering system and chassis



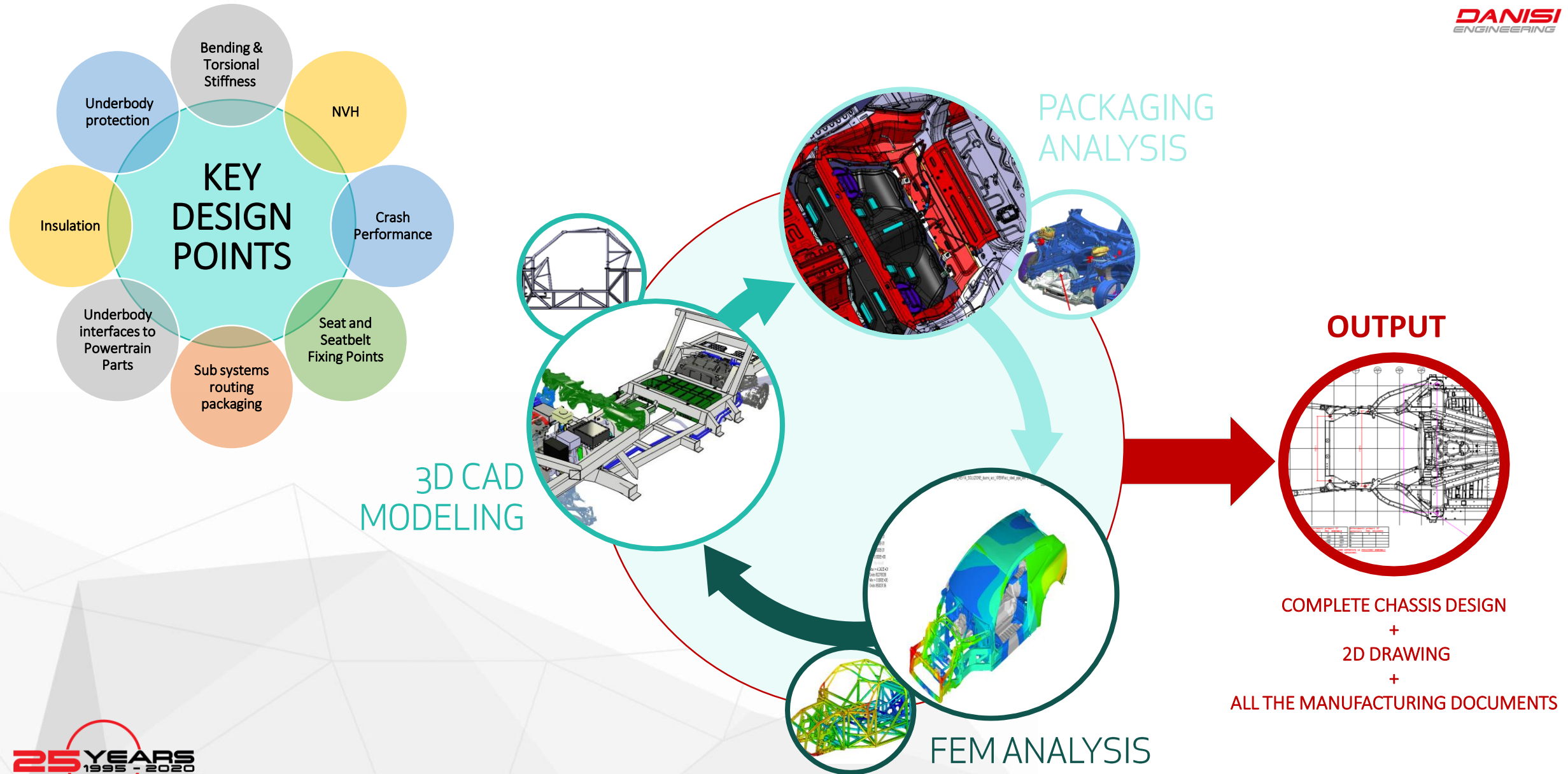
TIMETABLE OF TYPICAL DEVELOPING PHASE

COST & TIME ANALYSIS

Cost and time are essential aspects to be constantly monitored in any single phase of the project. Danisi Engineering integrated process involves specific tools for the scope.



FRAME DESIGN



CHASSIS DEFINITION

SAFETY REQUIREMENTS

The most important topic to deal with about the development of the chassis is safety.

The chassis must absorb as much of a crash impact as possible. If it doesn't a car can crumple up, with the driver and passengers inside. To avoid this situation, the chassis must be tough. It must also distribute crash energy along its length in the event of a rear or head-on accident.

Safety

The Chassis is the load-bearing framework of a vehicle, and the main functions are:

- To support the vehicle's mechanical components and body
- To deal with static and dynamic loads, without undue deflection or distortion.

These include:

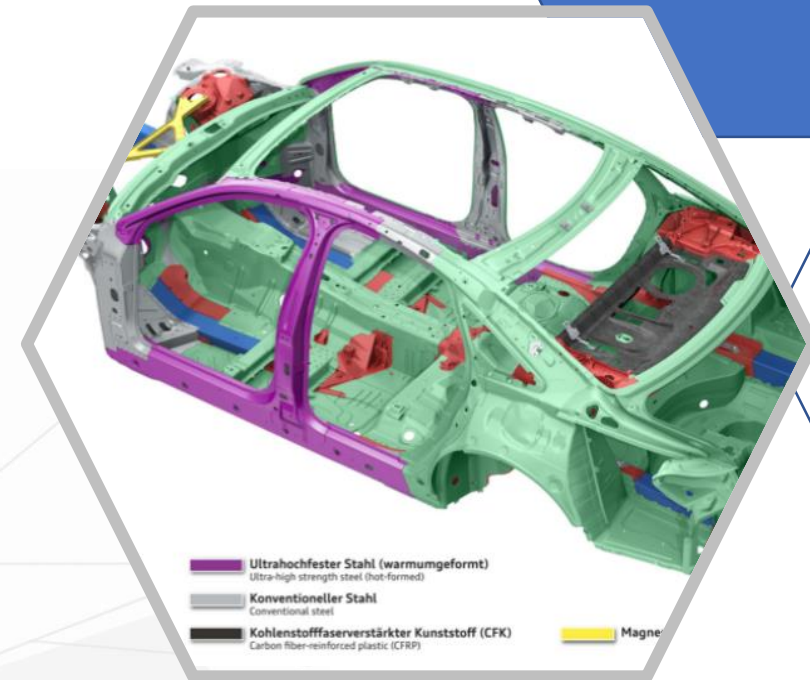
- Weight of the body, passengers, and cargo loads.
- Vertical and torsional twisting transmitted by going over uneven surfaces.
- Transverse lateral forces caused by road conditions, side wind, and steering the vehicle.
- Torque from the engine and transmission.
- Longitudinal tensile forces from starting and acceleration, as well as compression from braking.
- Sudden impacts from collisions.

INPUT
THEY HAVE
TO GIVE US

INPUT FROM
CUSTOMER/LAW

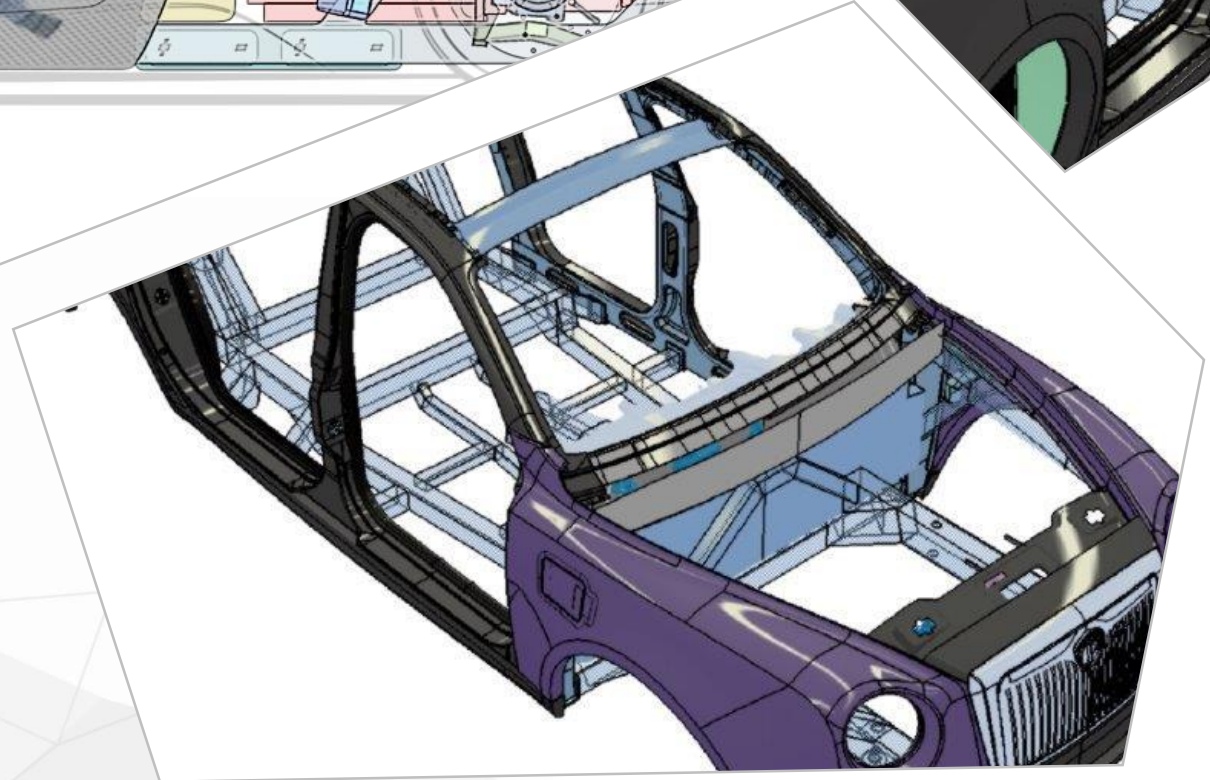
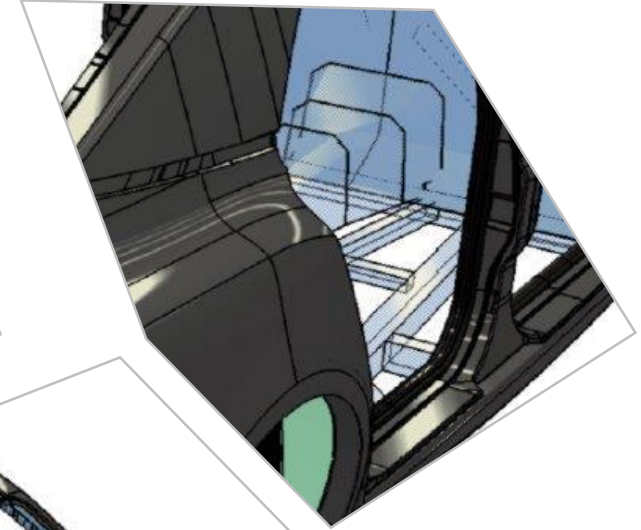
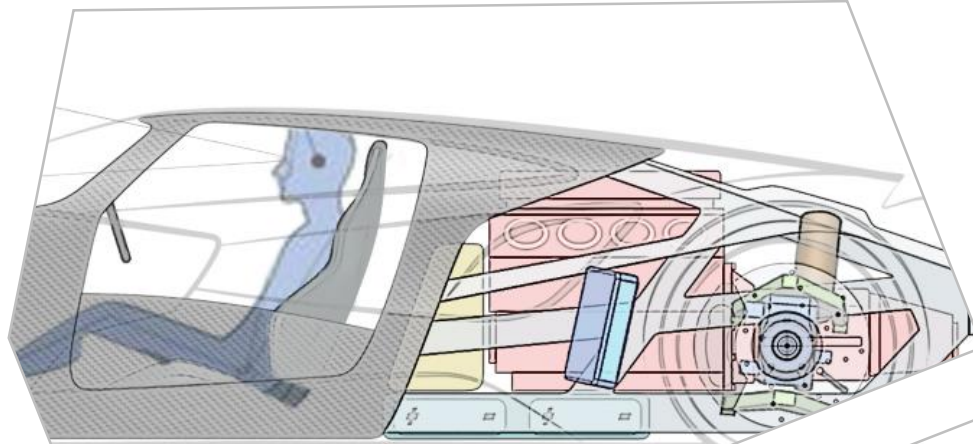
CAR CLASSIFICATION
CAR MISSION
HOMOLOGATIONS RULES

THINGS THEY
WANT US TO
INTEGRATE



CONCEPT PHASE MAIN OUTPUTS

- Chassis concept
- Packaging
- Vehicle typical sections



CHASSIS DEFINITION

ERGONOMICS REQUIREMENTS

In respect of International or Customer's Standards, thanks to a vehicle system approach.

Danisi Engineering is capable to define the complete packaging, providing suggestions, addressing potential issues and proposing solutions.

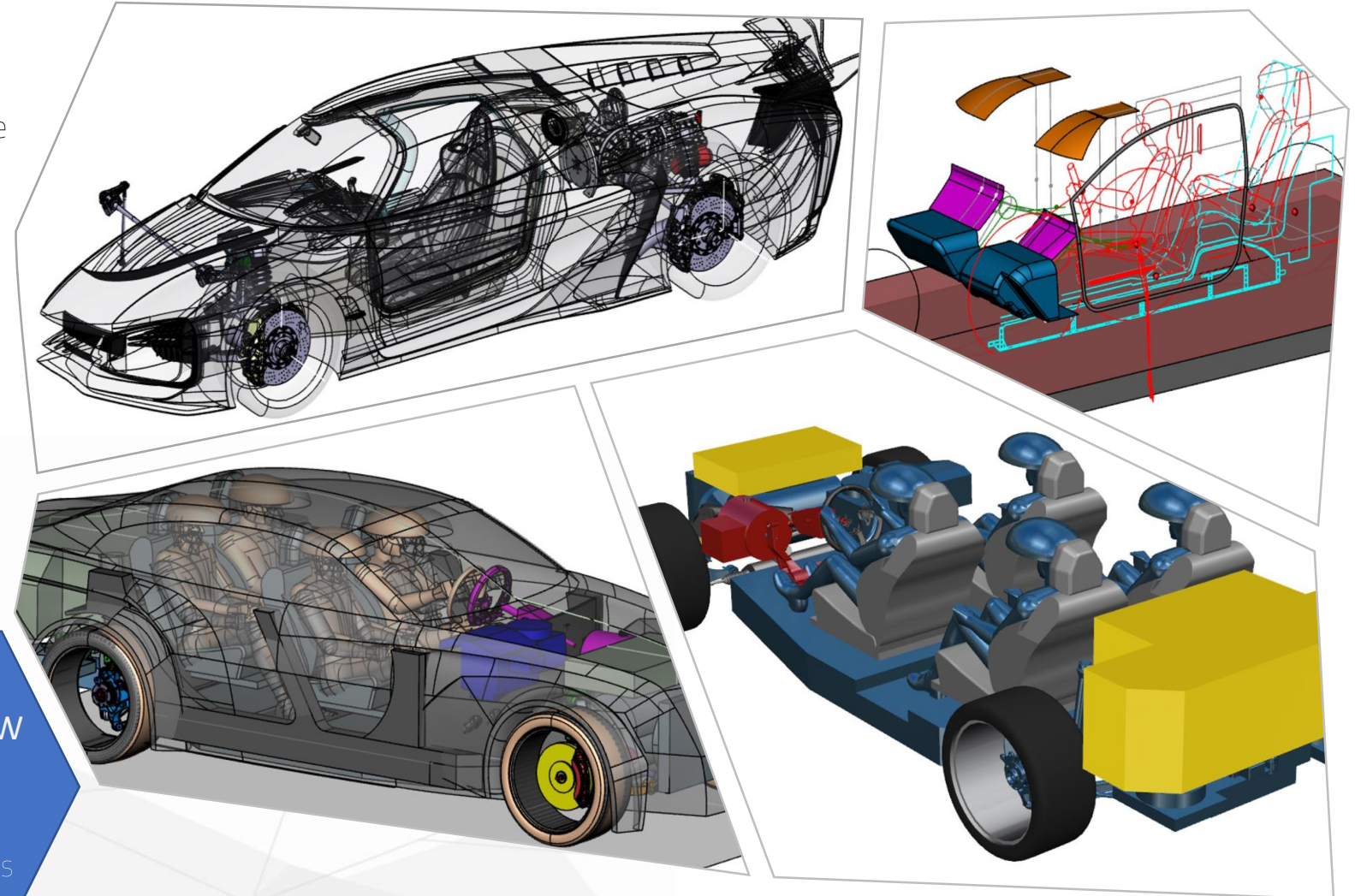
Ergonomics

In the Automotive field, it is mandatory to ensure to the passengers a high comfort level, defining some parameters and be focused on different details to achieve the desired target.

- Posture
- Vibrations
- Working loads

INPUT FROM
CUSTOMER/LAW

CAR CLASSIFICATION
CAR MISSION
HOMOLOGATIONS RULES



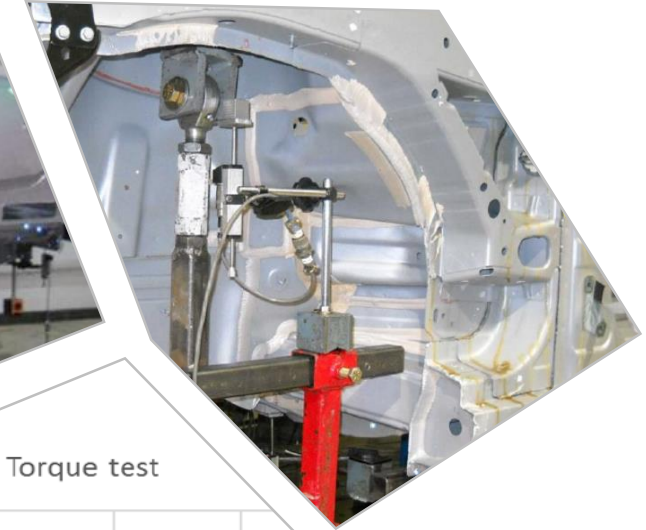
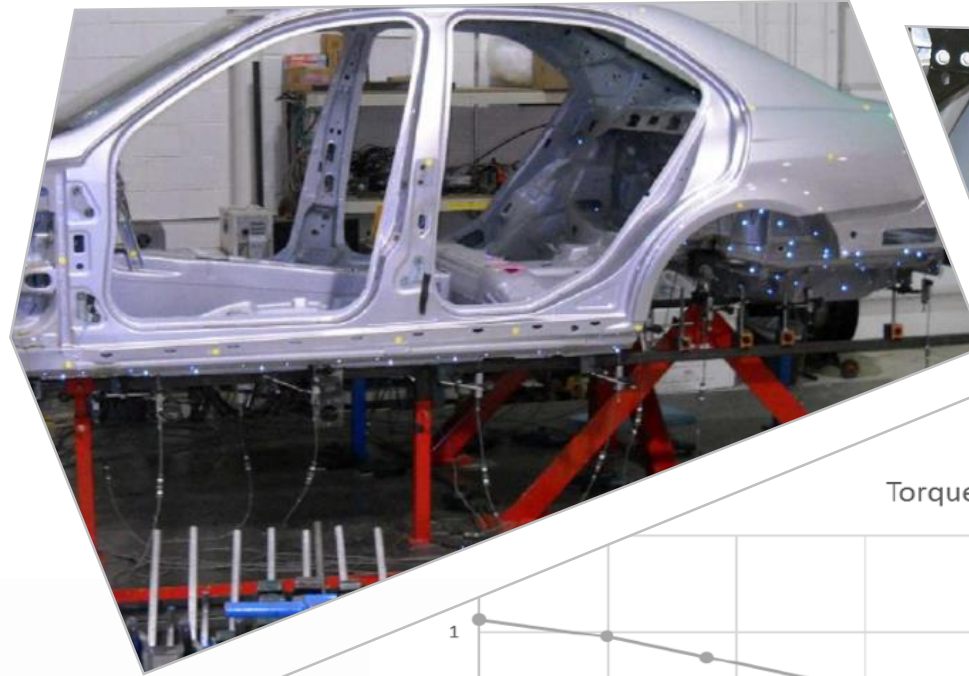
USE AND LOAD CASE DEFINITION

The values for the individual load cases are taken from the expected service conditions of the particular vehicle.

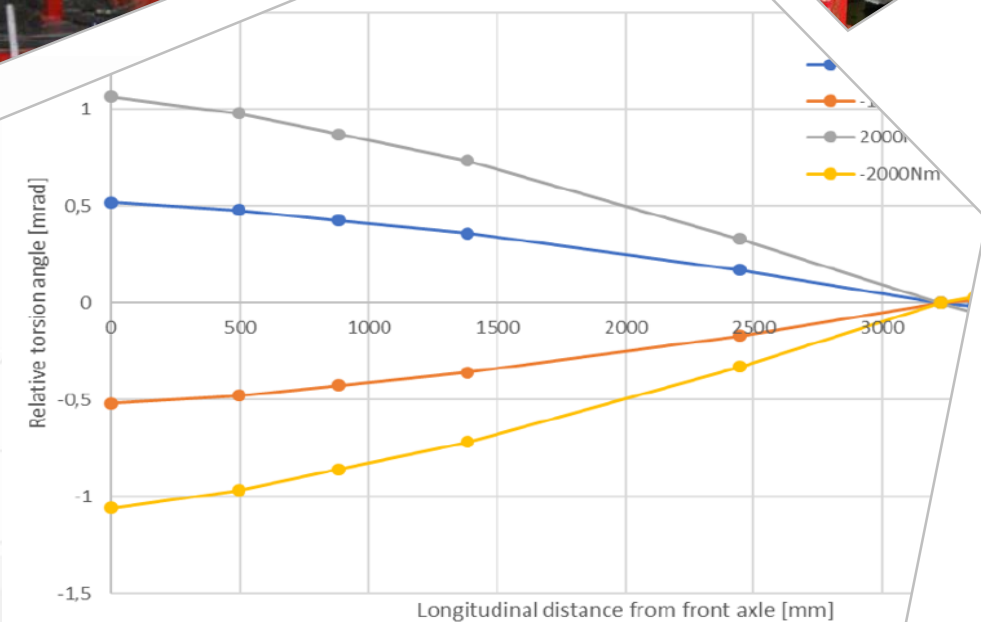
We have all this information due to our past experience and internal know-how in vehicle chassis related to the specific car segment.

If there is a reference car model on the market, we are also able to plan and develop all the benchmarking tests needed to have the reference target.

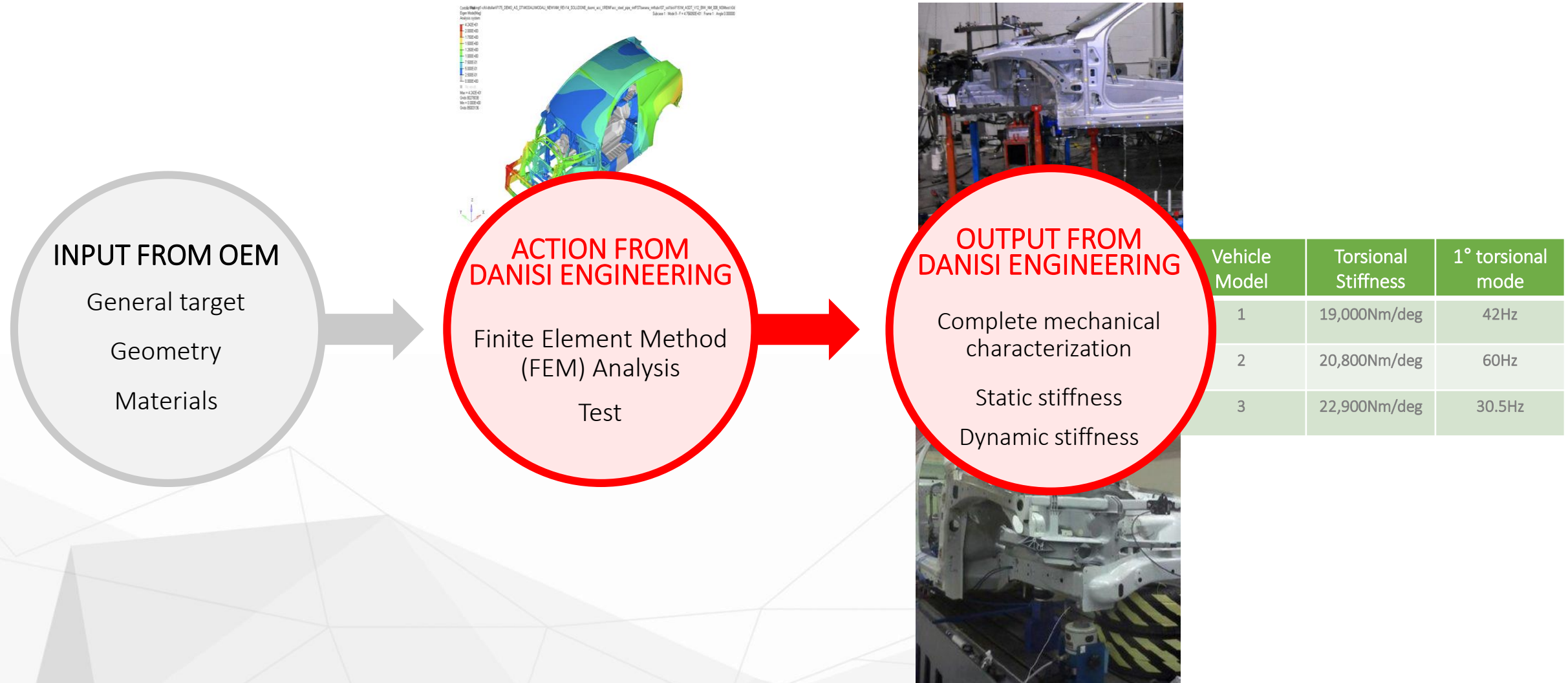
Based on the customer requirements of the vehicle mission, DE is able to forecast and define the structural requirements necessary to achieve the mission objectives.



Torque test



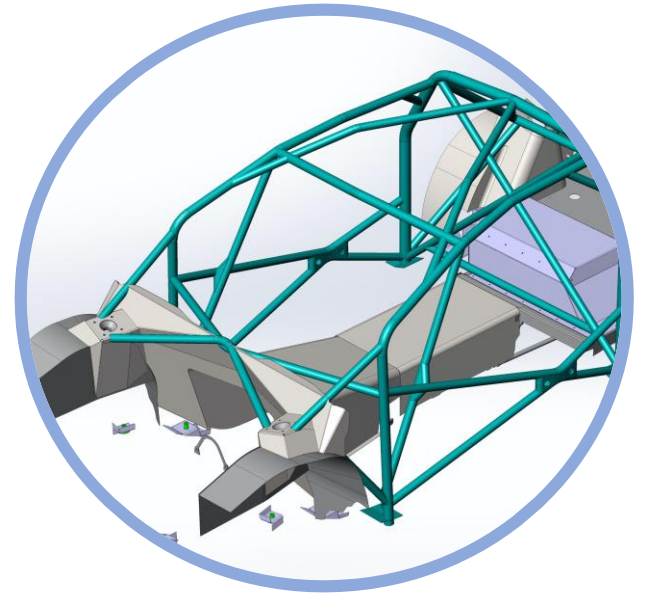
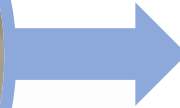
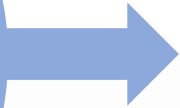
USE of Benchmark for TARGETS and LOAD CASE DEFINITION



Structure Scan

CAD Drafting

CAD Refinement



REVERSE ENGINEERING

In this process a benchmark chassis is deconstructed to reveal its designs or architecture in order to extract knowledge from the object.



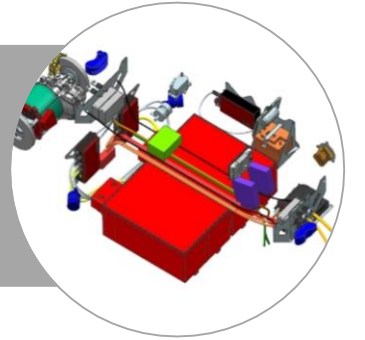
TARGET SETTINGS AND CASCADING

Detailed target setting is the conclusion of the concept phase, providing directions for the further phases, and it could be the value of the cell package's stiffness that will give its contribution to the vehicle chassis stiffness and robustness.

Frame stiffness
contribution to
the total stiffness

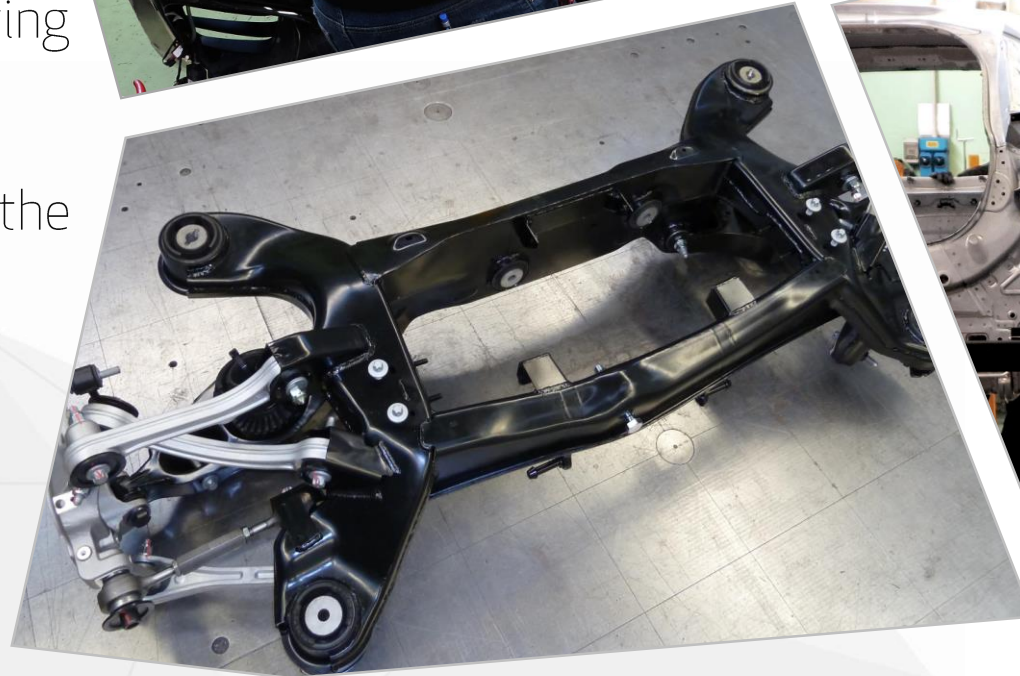
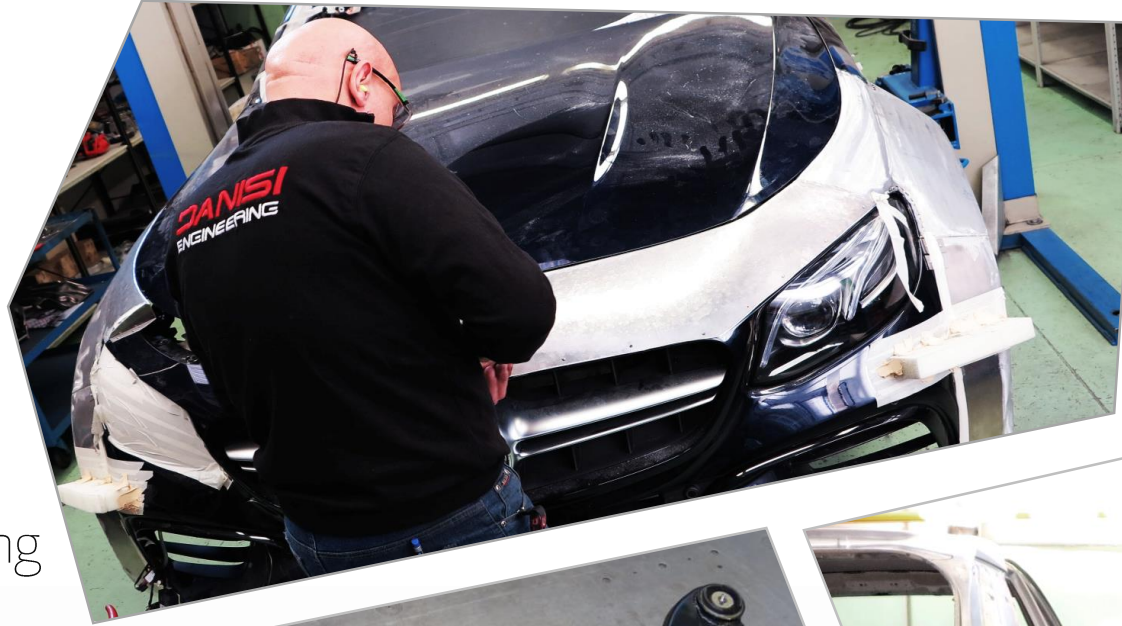


Defining the contribution
of each components to
the functional
requirements of the
chassis



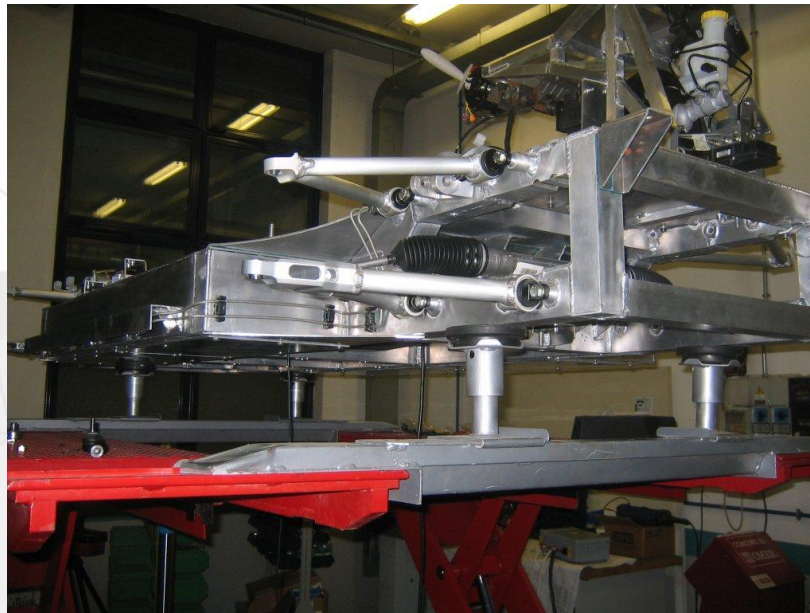
PROTOTYPE BUILDING

Prototypes are built and assembled taking in tight consideration their specific finalities. Understanding aims and missions, Danisi Engineering concentrates on the fundamental aspects, performances and targets of the vehicle.



PROTOTYPE BUILDING AND INTEGRATION

Sub-systems



PROTOTYPE BUILDING AND INTEGRATION

Car body



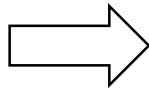
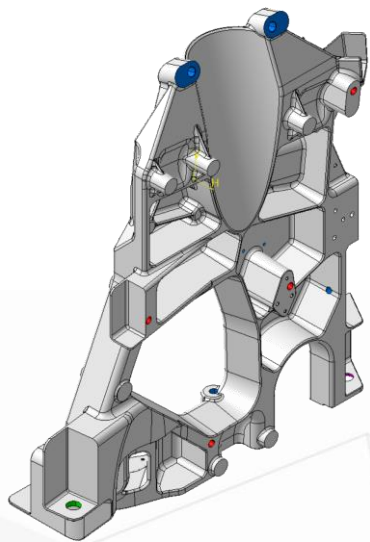
PROTOTYPE BUILDING AND INTEGRATION

Integration

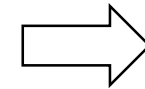
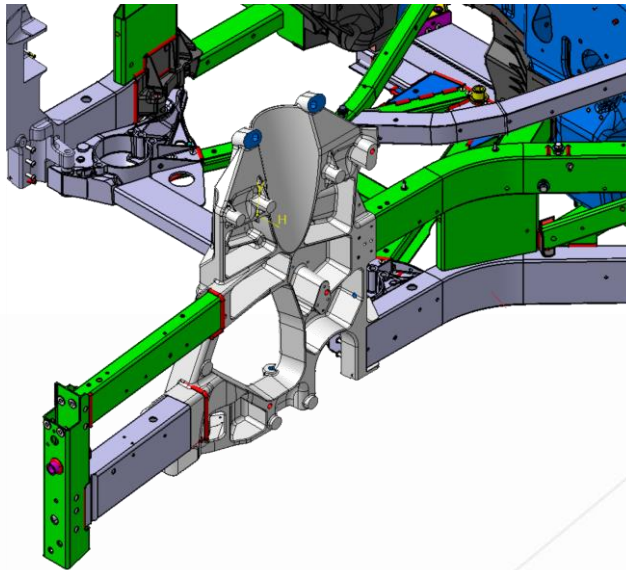


EXAMPLE OF ALUMINUM FRAME BUILDING PROCESS

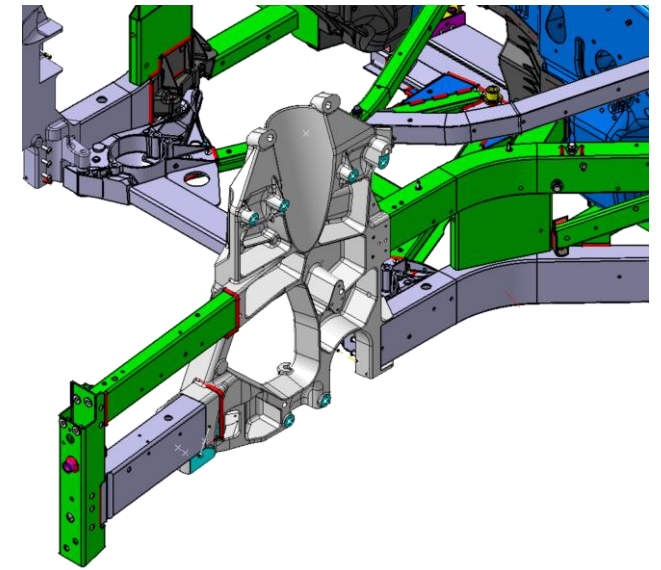
Frame milled part



Welded integration



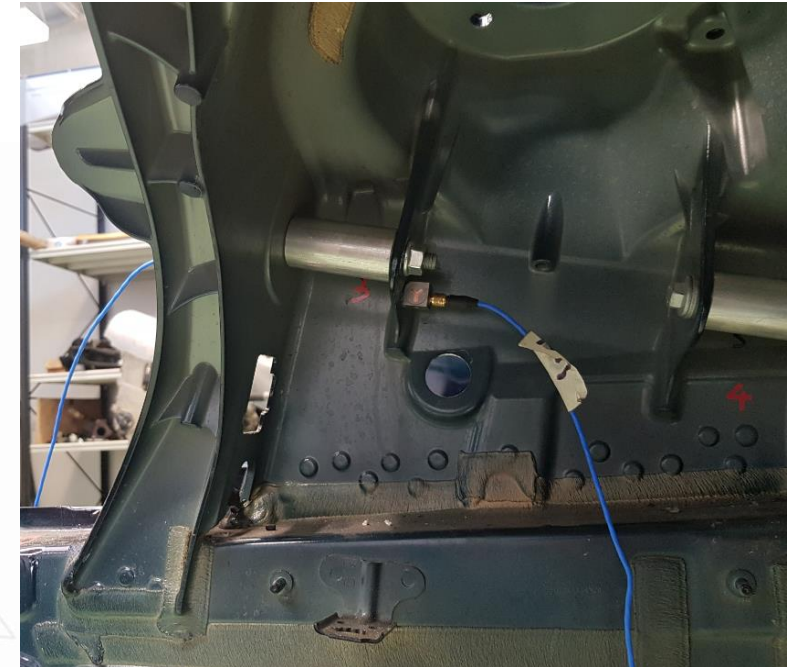
Postwelding machining



CASE STUDY: BODY MODIFICATION

Example of typical activities of Mules based on a donor/reference vehicle

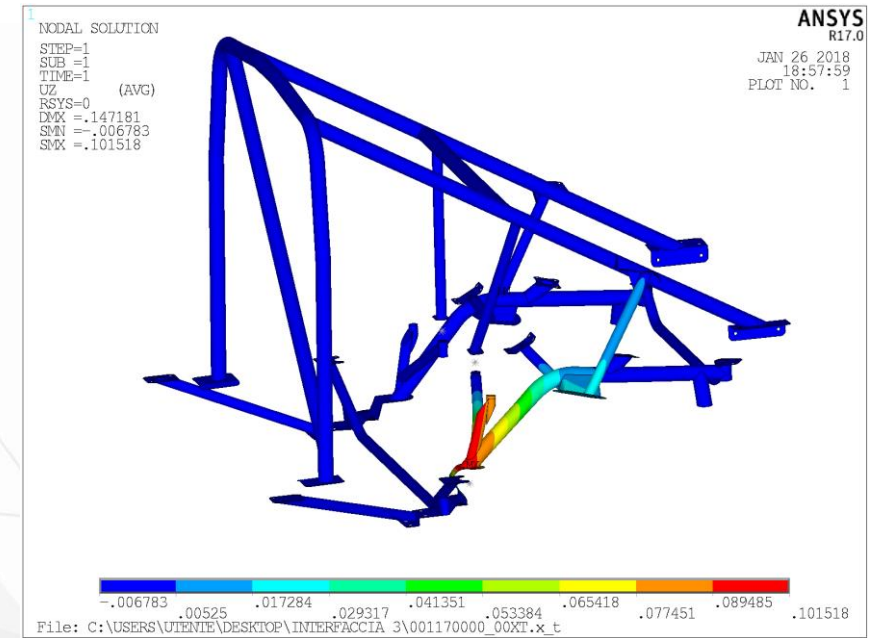
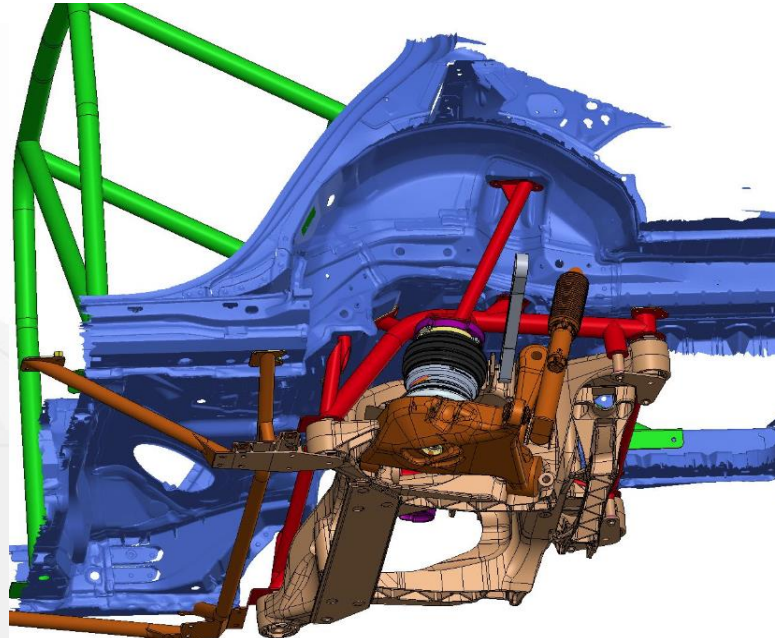
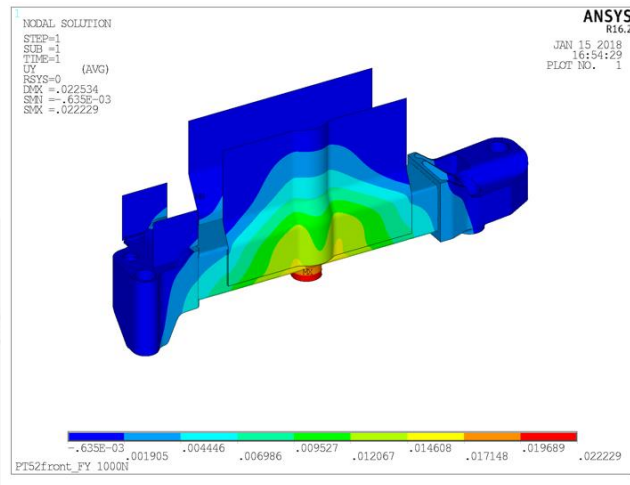
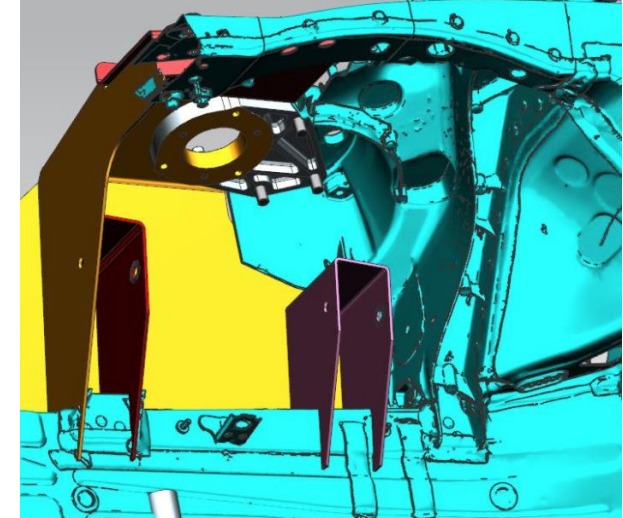
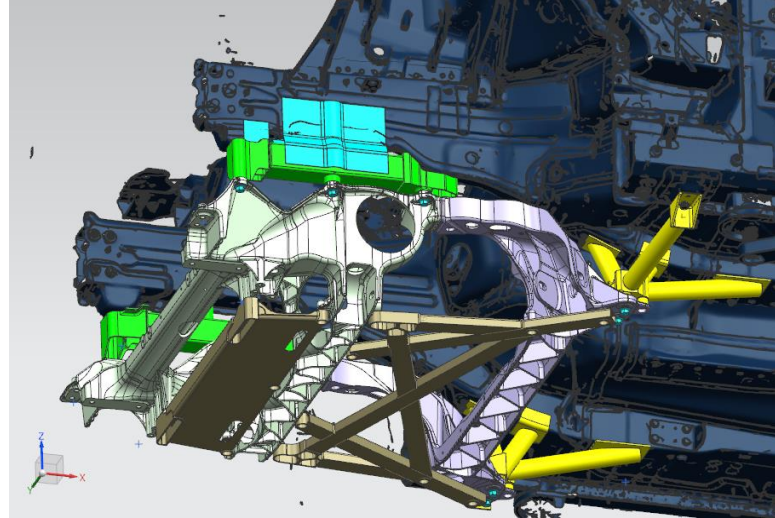
- BODY vs. CHASSIS POSITIONING TO CHECK WIRING AND SYSTEMS LAYOUT
- VEHICLE DISMOUNTING and REVERSE ENGINEERING
- EXTERNAL BODY PREPARATION/ADAPTATION
- SUSPENSION ATTACHMENT STIFFNESS MEASUREMENT



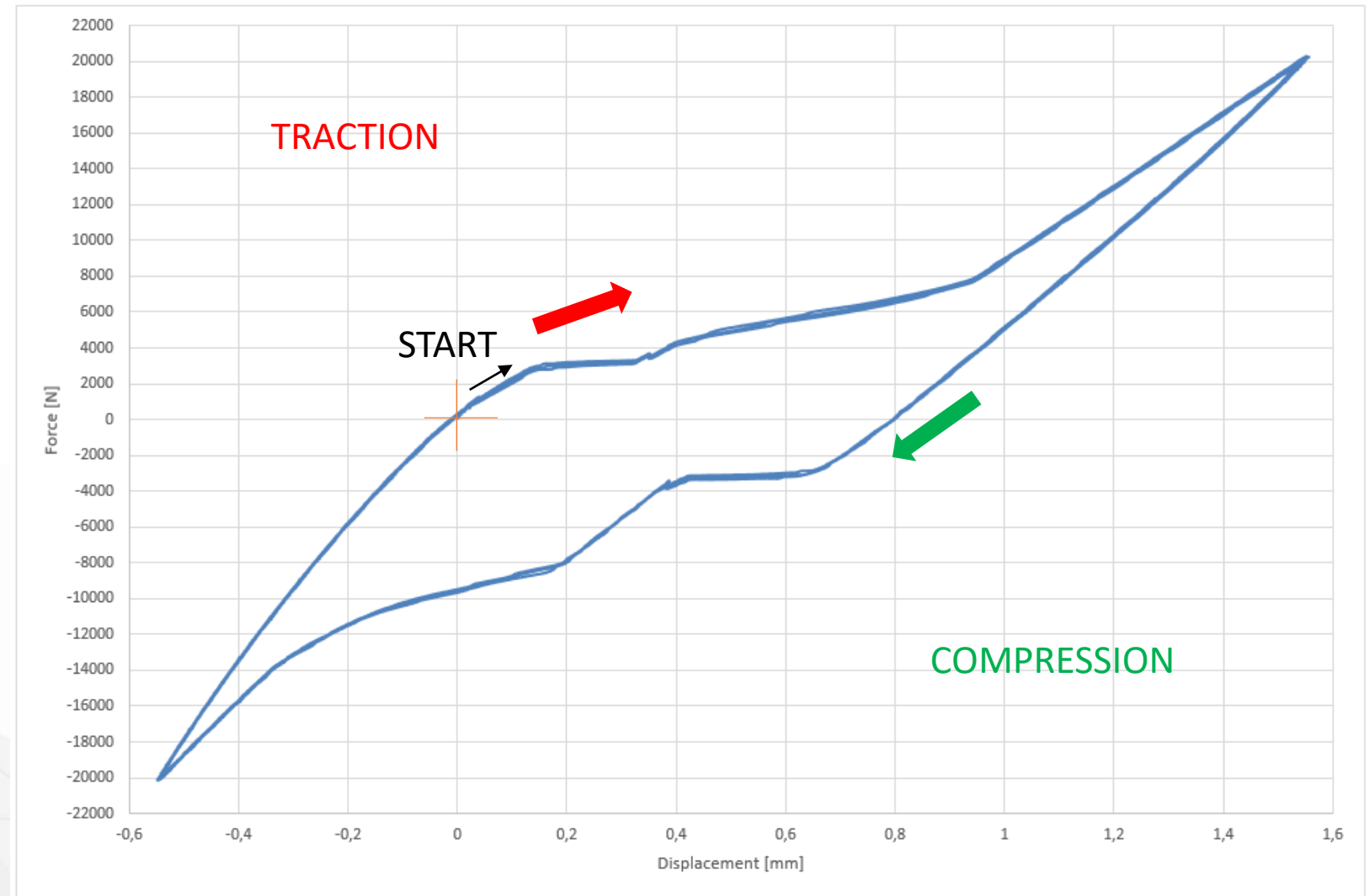
FRAME MODIFICATION

DESIGN OF NEW SUPPORT

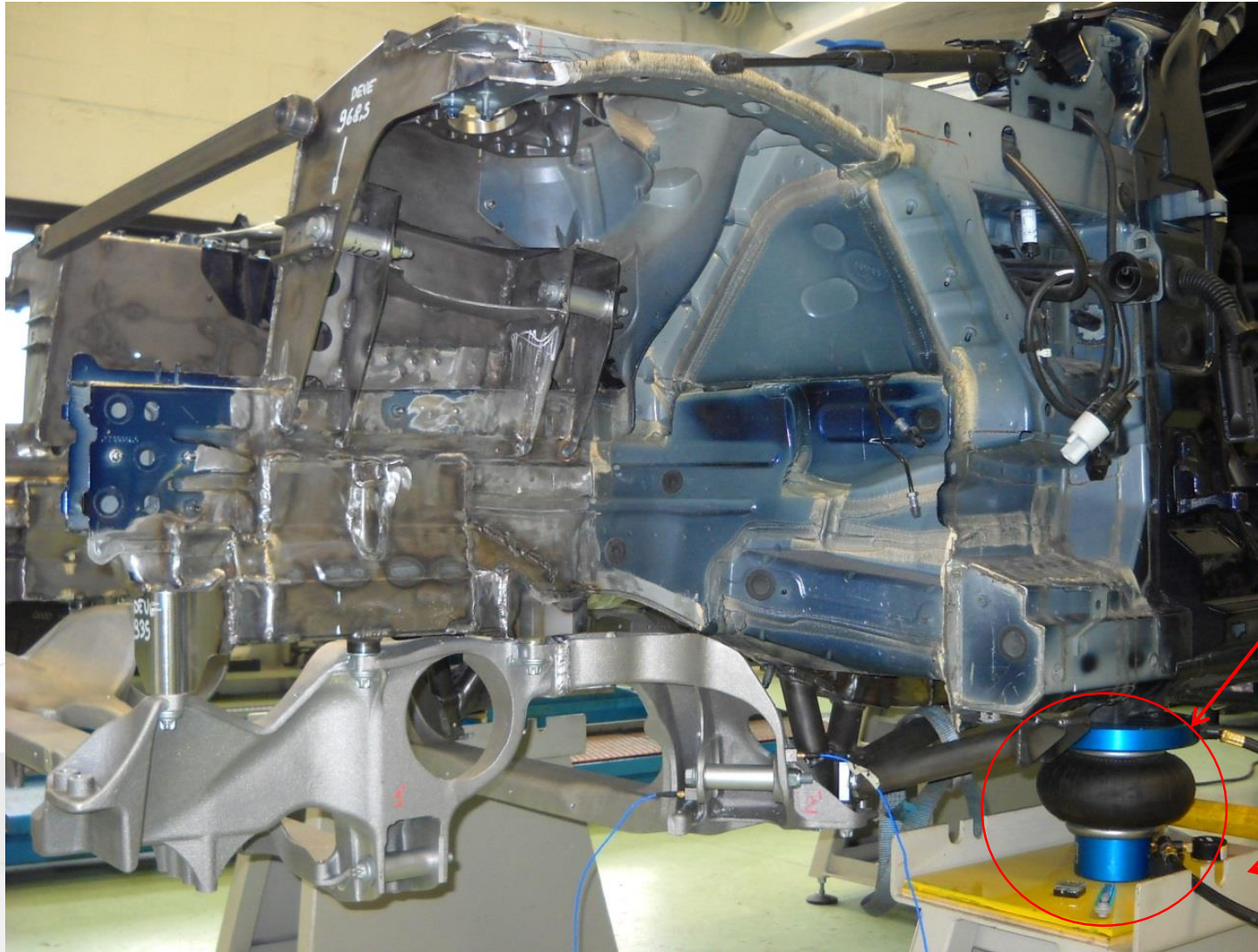
- FRONT SUBFRAME
- FRONT DOME
- REAR SUBFRAME
- REAR DOME
- ROLL CAGE
- GEARBOX SUPPORT



CLAMP AND SLIP TEST – COMPRESSION & TRACTION



DYNAMIC STIFFNESS TEST

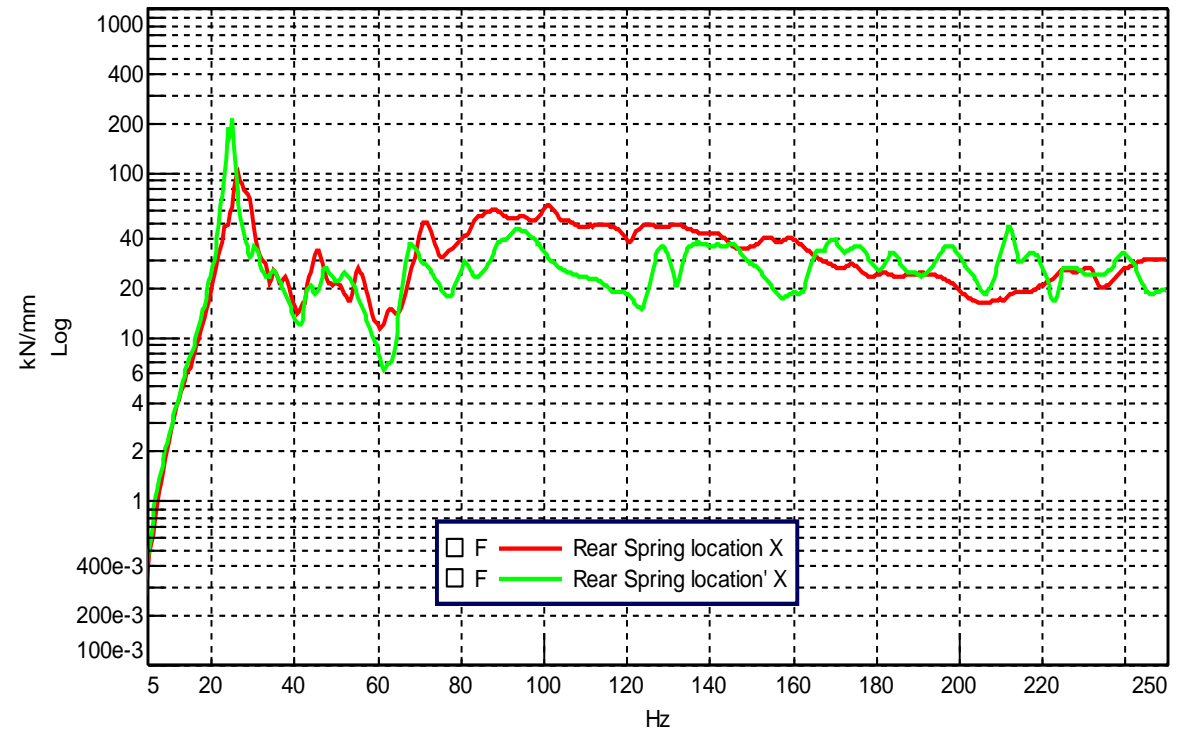


AIR SPRING

RIGID TRESTLE

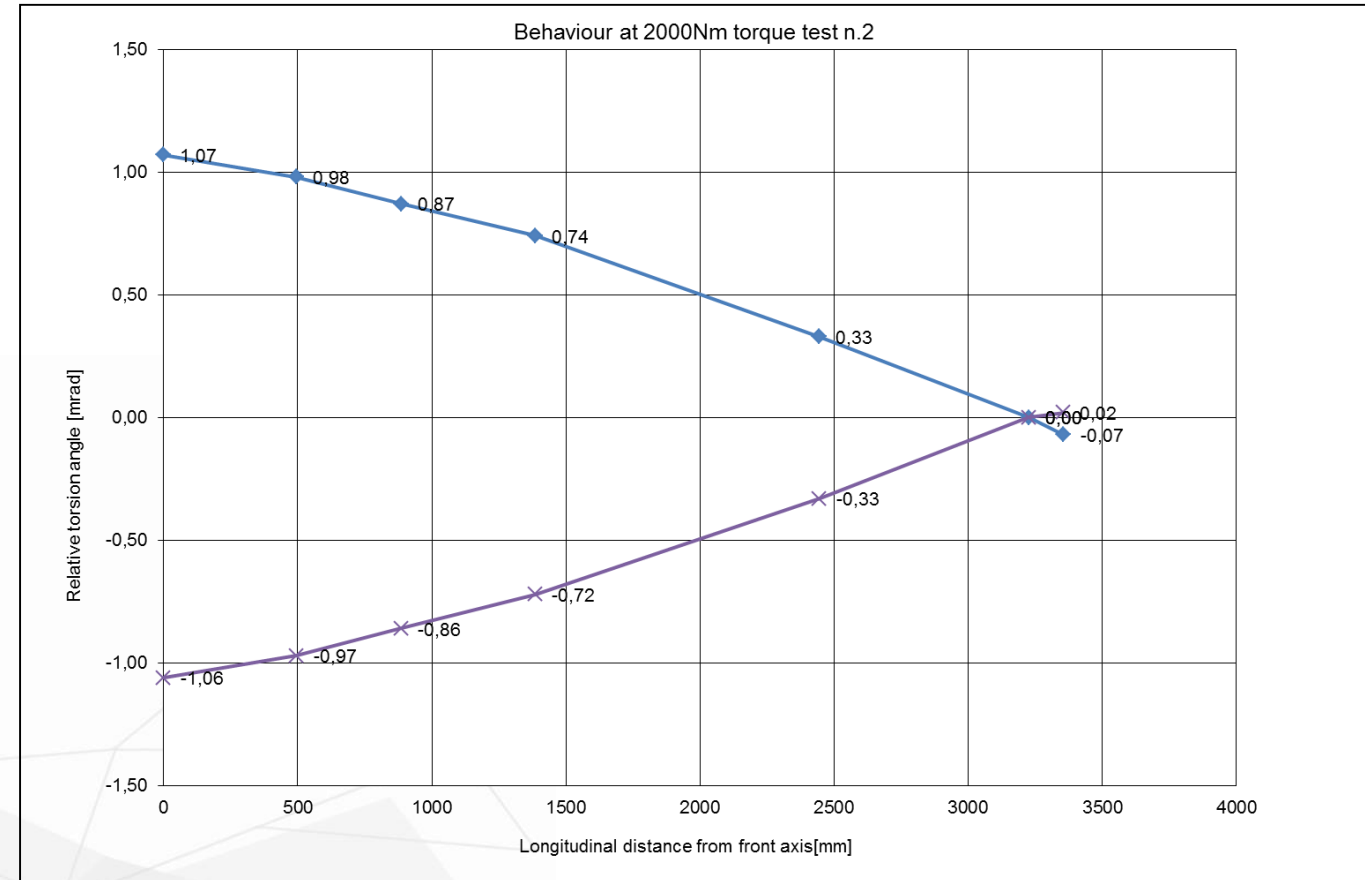
BIW positioned on air springs

RESULTS (i.e. on rear spring seat)



Comparison with reference vehicle

STATIC TORSION STIFFNESS



Relative torsion angle at 2000Nm



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