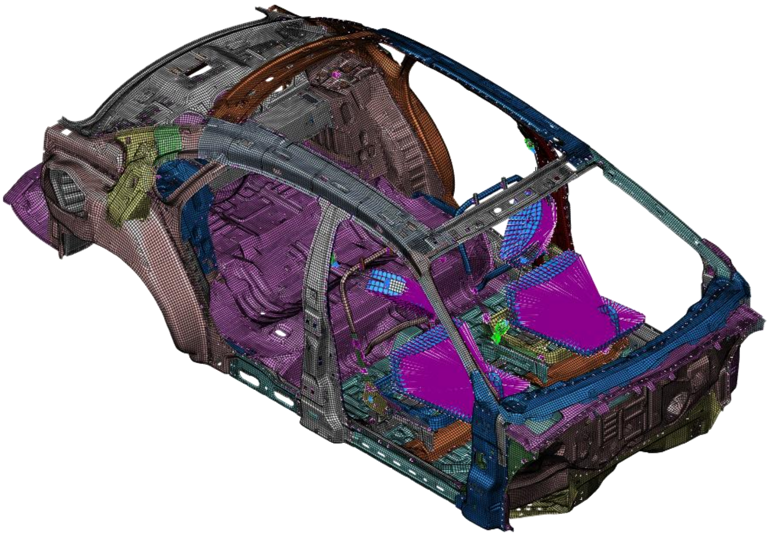
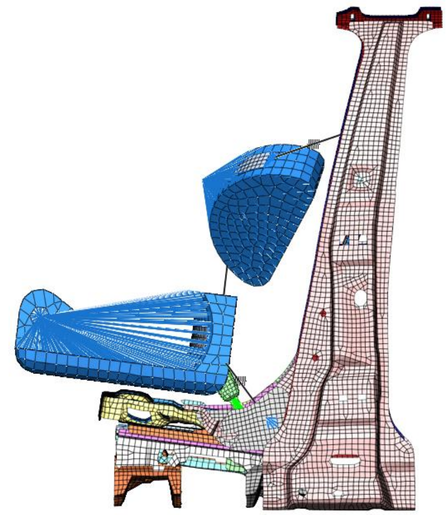
Midas NFX project application

Seat Belt Anchorage Analysis - ECE R14





Seat belt system need to be sure enough in case of vehicle impact. In order to guarantee its proper function, static test loads representing vehicle impact are applied to it and belt anchorages have to resist. The test ECE R14 is one of the tests that provide the assurance of sufficient strength resistance of all anchorage points.

Figure 1.1 Loading device of ECE R14 test

Figure 1.2 Seat belt anchored to loading device

In these tests, high forces are applied to the seatbelts over loading devices. All the components of the systems, including seats and belt anchorages have to resist the defined loads without damage.

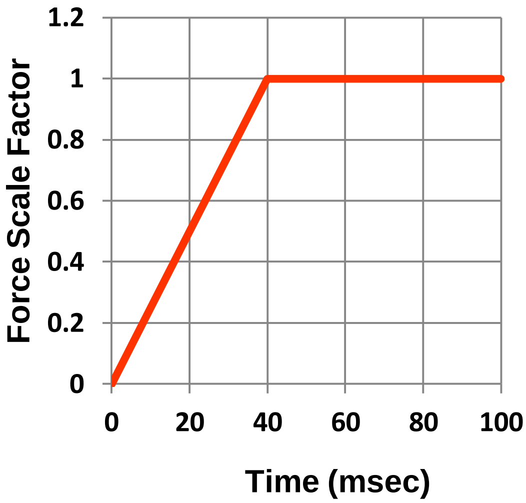


Figure 2.1 Load Time curve

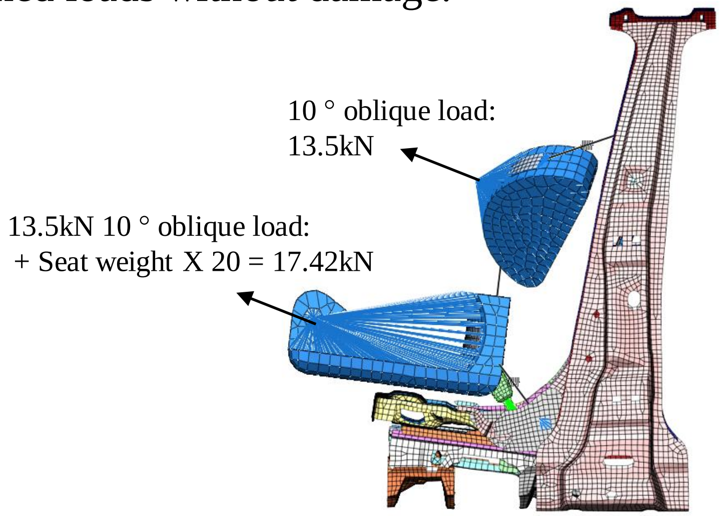


Figure 2.2 Seat and seat belt anchorage FE model

Loading device is not directly tied to the seatbelts or the seats, so contact and slipping can occur. The seat, seatbelt, seat anchorage and loading device form a complex kinematic system and its configuration under load determines the applied load to the anchorage points. Thus, a correct FEA modeling is essential for significant and accurate computational results.

Value of the loads is defined by the ECE R14 regulation in function of the vehicle's weight (cf. table 1) .

classification	**m<3.5 t**	**3.5t<m<12t**	**m>12t**
Shoulder Block	13.5 kN	6.75 kN	4.5 kN
Lap Block	13.5 kN	6.75 kN	4.5 kN
Seat	20 x seat weight	10 x seat weight	6.6 x seat weight

Table 1 ECE R14 test loads

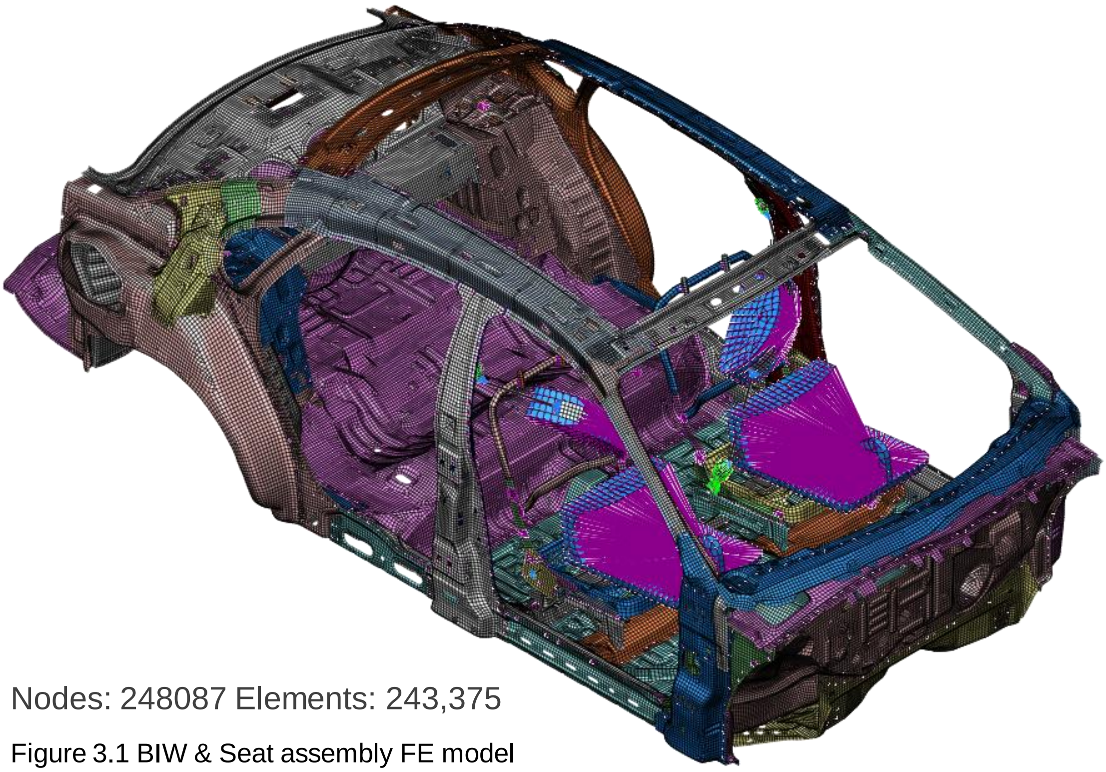


Figure 3.1 BIW & Seat assembly FE model

BIW & Seat assembly finite element model consisted of 243,375 elements and 248,087 nodes. Different nonlinear material models have been applied to the components of the system (ref Table 2 and picture 4.1)

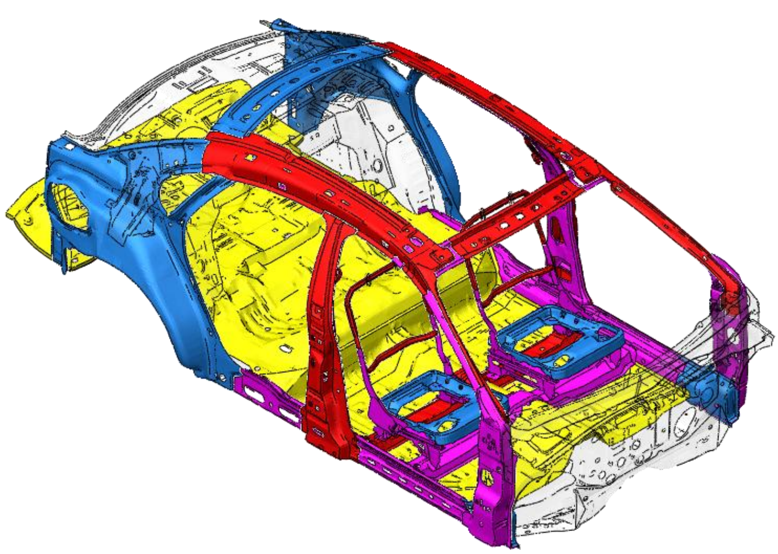


Figure 3.2 BIW & Seat assembly FE model with material properties in different colors

	Modulus of elasticity (N/mm^2)	Poisson's ratio	Density (kg/mm^3)
Elastic materials	210000	0.3	7.89e−6
210Y	210000	0.3	7.89e−6
240Y	210000	0.3	7.89e−6
300Y	210000	0.3	7.89e−6
800Y	210000	0.3	7.89e−6

Table 2 material characteristics

Figure 4.1 material Stress-strain Curves

Four different nonlinear material models have been used, with yielding stress going from 210 Mpa to 800 Mpa for the stiffer parts.

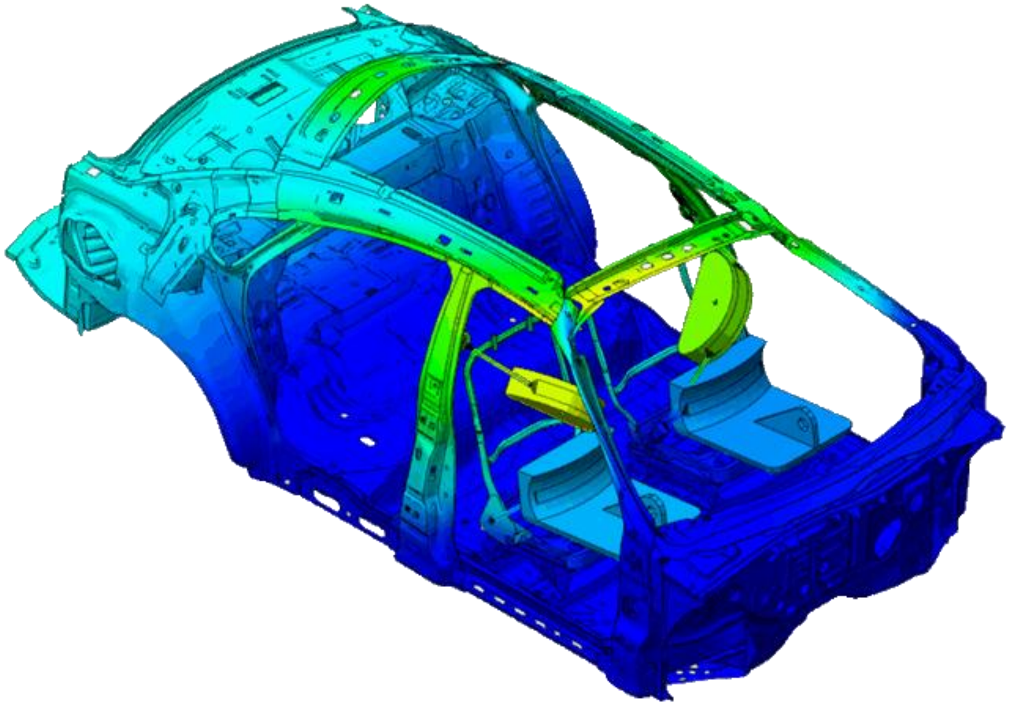


Figure 5.1 Displacement analysis results of BIW & Seat assembly FE model

Finite element analysis have been performed using midas NFX nonlinear dynamic explicit solver. When performing this kind of analysis, it is very important to set correctly the global damping constant with respect to the relevant eigenmodes of the structure in order to suppress unwanted dynamic effects.

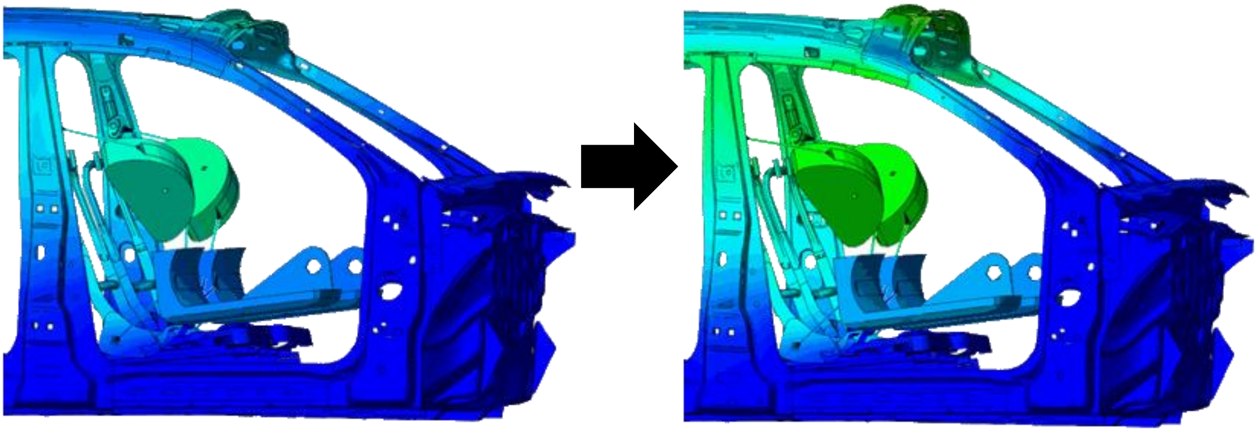


Figure 5.2 Displacement analysis results of Seat assembly FE model

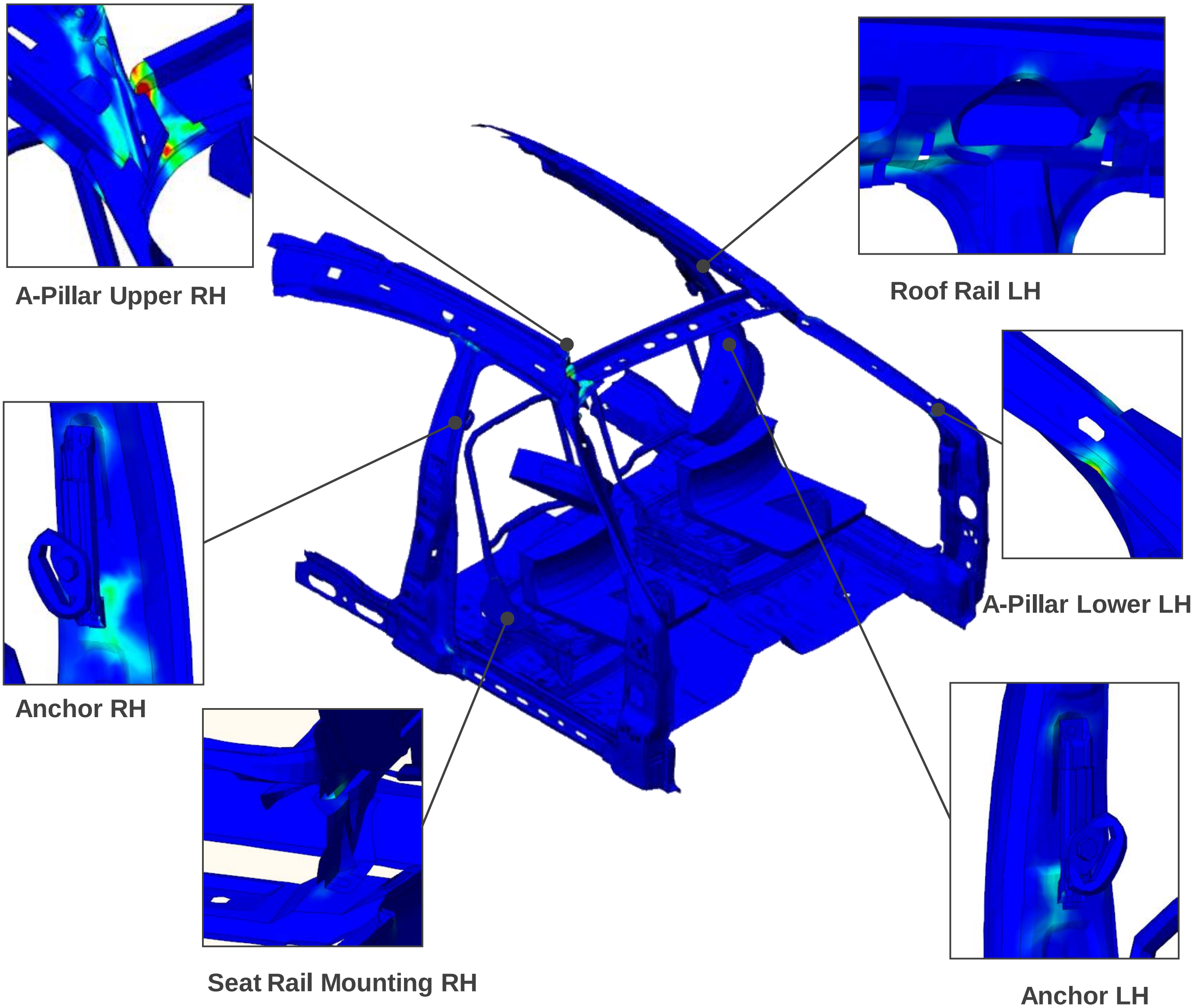


Figure 5.3 Effective Strain analysis results of BIW & Seat assembly FE model

Effective strain results given by midas NFX were useful to determine the most vulnerable parts of the BIW structure like the A-Pillar upper RH, where buckling of the structure appeared. Midas NFX helped the engineers to get faster modeling and simulation for seat belt anchorage systems.