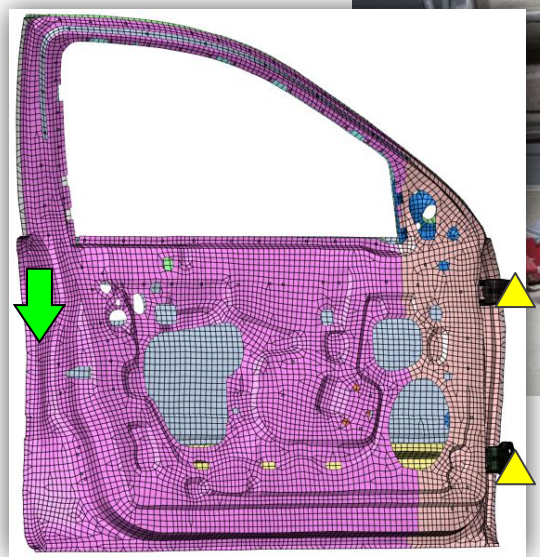
Vehicle door stiffness analysis

Introduction

Door assembly is a very important part in vehicle design because its frequent interaction with outside world. Designers face so many different problems during the vehicle door design such as weight, cost, excessive reinforcement, water leakage, etc. FEA analysis can help designers to reduce lead time as well as cost of design and meet various design goals. This article introduces 2 common analysis types performed on vehicle doors with midas NFX software: **door vertical stiffness analysis** and **door shell stiffness analysis.**



Door vertical stiffness analysis

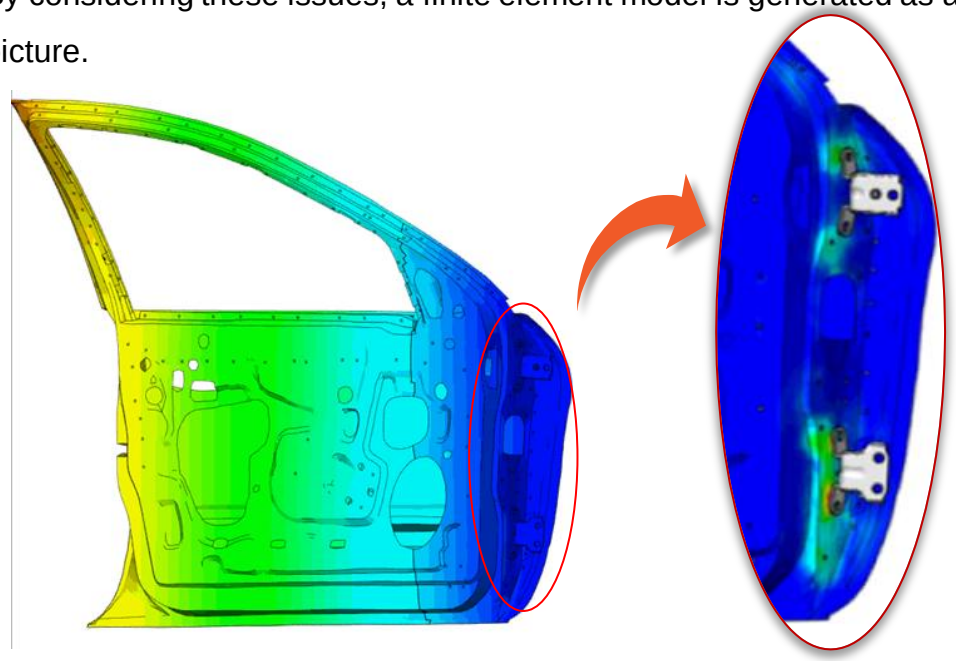
To perform door vertical stiffness analysis, 3 principle issues need to be considered:

Firstly, indentify deflection between door and vehicle body due to door's weight.

Secondly, indentify total deformation and permanent deformation due to excessive vertical load applied to the door by careless user.

Thirdly, perform vertical load at door latch when door hinge is restrained.

By considering these issues, a finite element model is generated as above picture.

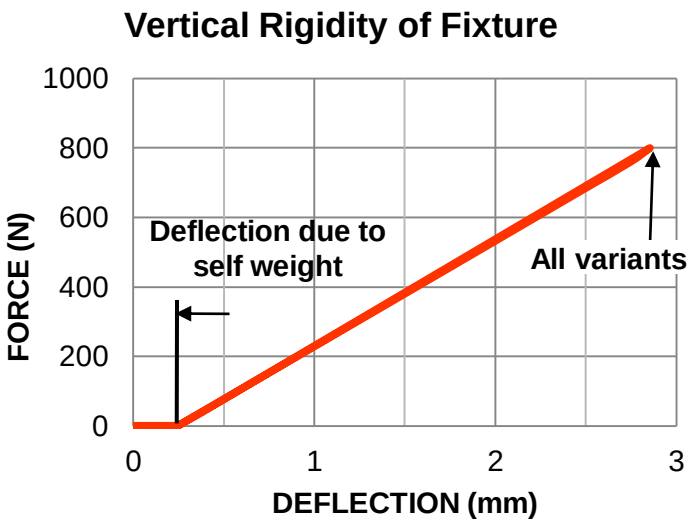


Vertical displacement distribution

Stress distribution (Hinge)

Above analysis is performed by midas NFX linear static analysis. From the result we can see displacement and stress distribution. By observing stress at hinge part we can indentify if inner panel is damaged.

Look at the graphic on the right. At first the deflection is quite small due to door's self weight. However this deflection become larger when excessive vertical load is applied . Check the elasticity restoration when load is removed and make sure permanent deformation won't occur.

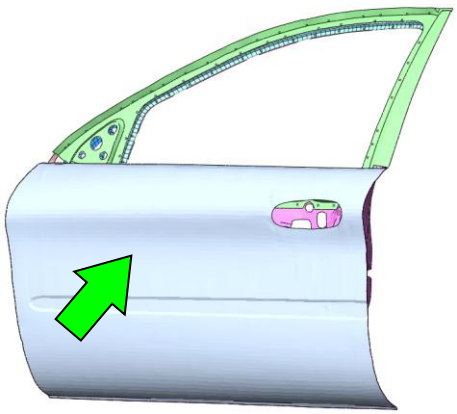


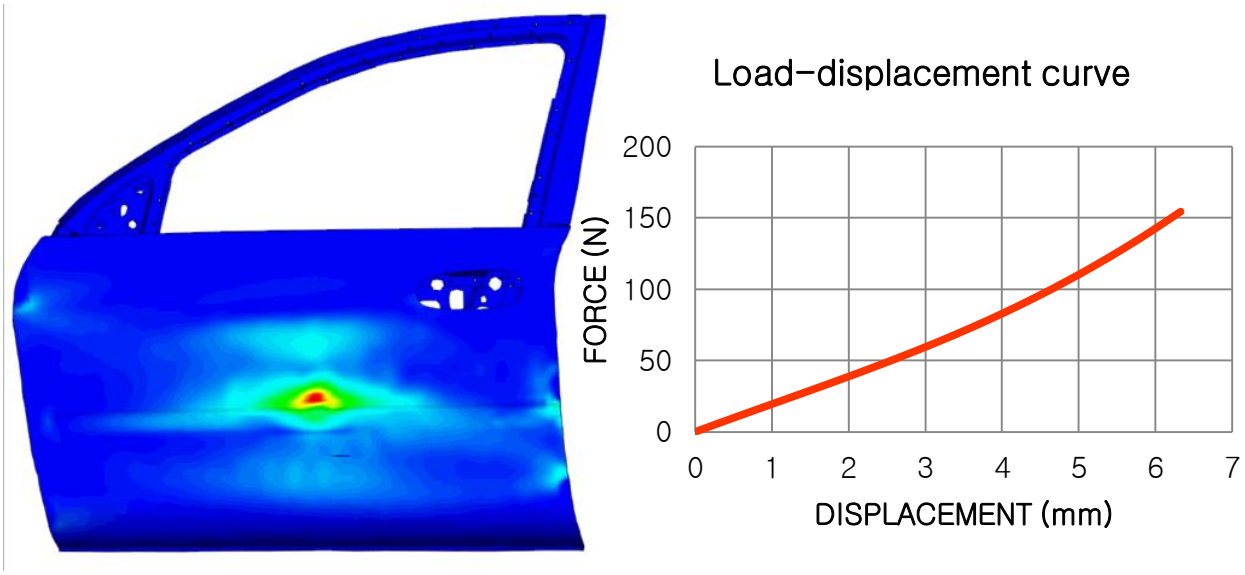
Door shell stiffness analysis

Now we'll discuss door shell stiffness analysis. 2 major issues in door shell stiffness analysis are:

Firstly, stiffness need to reach a certain level because of the high frequency of contact with the outside of the door shell.

Secondly, check the deformed shape and permanent deformations due to user's behavior such as kicking the door.





displacement distribution

Above analysis is performed by midas NFX linear static analysis. Picture shows door shell's deformation when force is applied to the middle of the car door. And through the load-displacement curve, we can indentify the stiffness of the car door shell.