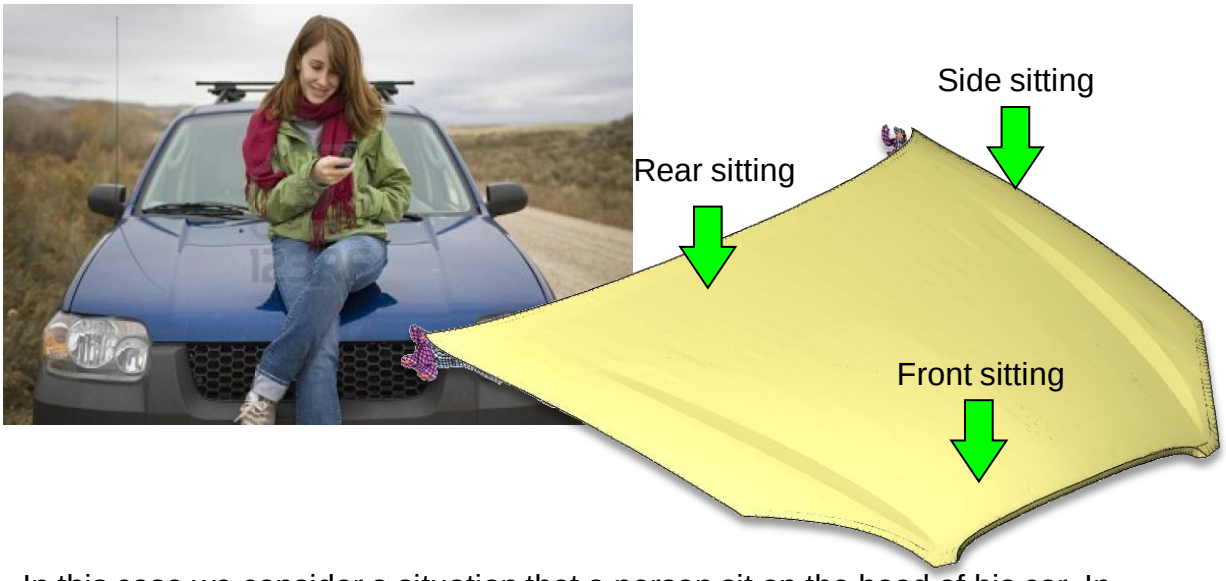
Vehicle closure analysis (hood & trunk)

Introduction

In this article we will talk about vehicle closure related analysis, 2 common cases are introduced: **Stiffness Analysis of Car Hood** and **Lateral & Torsional Stiffness Analysis of Trunk Lid**

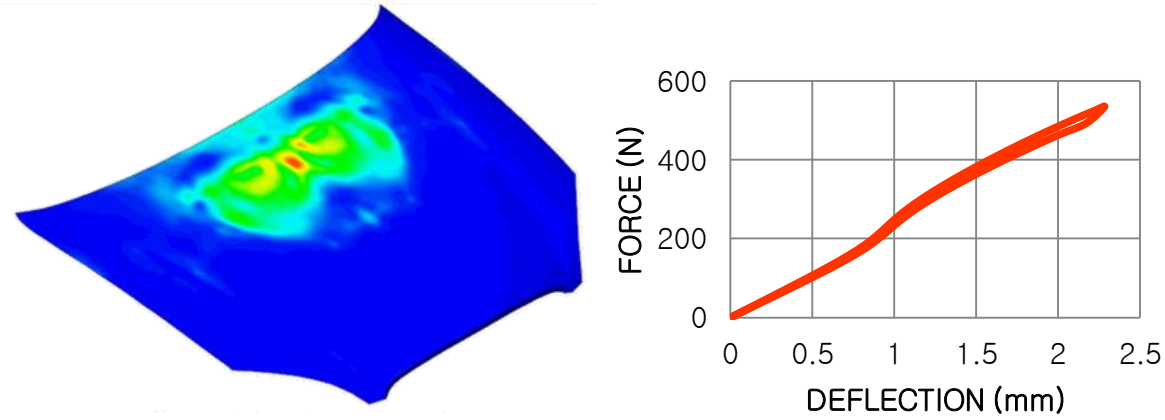
Sitting hood stiffness analysis



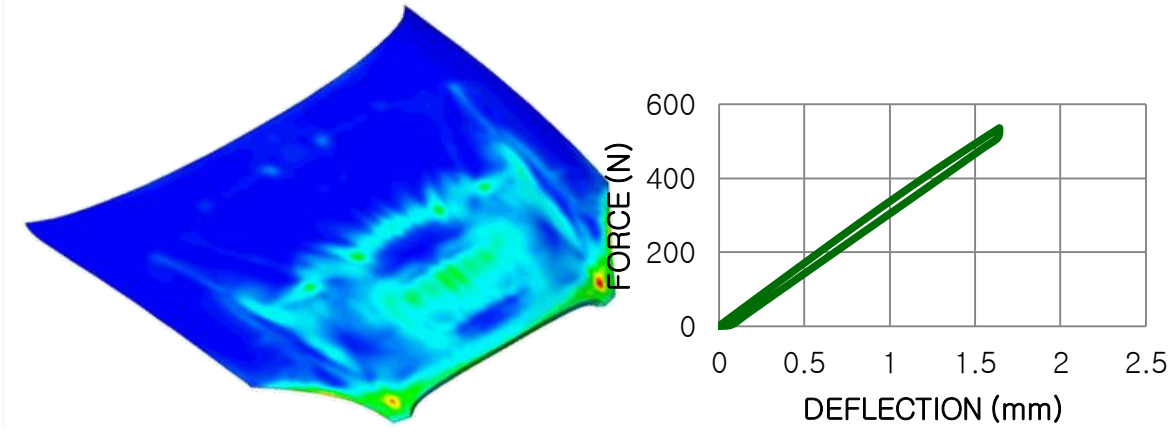
In this case we consider a situation that a person sit on the hood of his car. In order to prevent permanent deformation, car hood should reach certain stiffness. For a general case, we assigned load to front, rear and side part of the car hood respectively and check if there's permanent deformation.

Analysis is performed by midas NFX linear static analysis. Following images and charts show stress distributions and force-defection curves under rear sitting and front sitting conditions.

From the curve we can also conclude that for rear sitting case there is no permanent deformation. However for front sitting case there is a tiny permanent deformation.



Stress distribution - Rear sitting



Stress distribution - front sit

Lateral & Torsional stiffness analysis of trunk lid

In this case, vibration occurs when vehicles drives on unpaved road . Paint on the door or body will be removed and tail lamps will interference with one another due to vibration. To prevent this situation, a simple linear analysis is used to insure minimum stiffness of the trunk.

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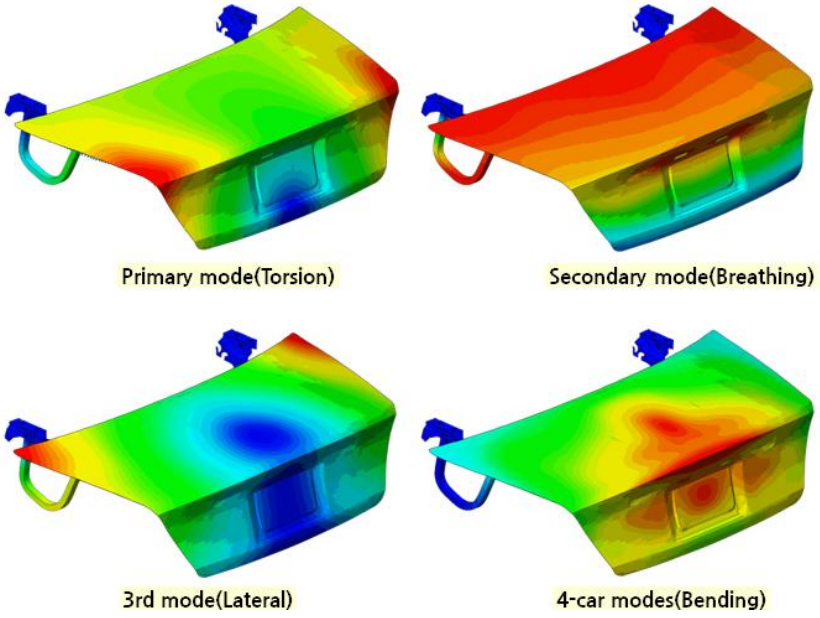
Modal Analysis of Trunk Lid - indentify natural frequency

To make sure linear analysis is appropriate for the problem. We firstly perform a model analysis on trunk lid with midas NFX to decide natural frequency of the structure.

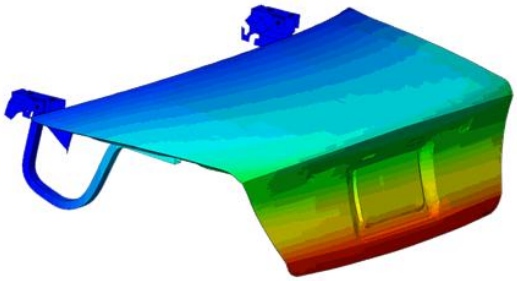
Mode	Natural frequency
1st	26.9 Hz
2nd	31.8 Hz
3rd	40.8 Hz
4th	44.5 Hz
5th	51.4 Hz
6th	56.2 Hz
7th	59.1 Hz
8th	61.0 Hz
9th	61.4 Hz
10th	68.3 Hz



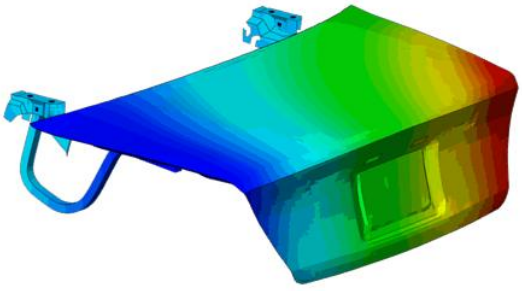
Natural frequency of trunk lid can be observed in the above result. In this case when the car is in idle state, the engine rotation is between 700 ~ 800rpm, which means to prevent resonance, natural frequency of 23.3~26.7Hz need to be avoided. Since natural frequency of trunk lid is not in this range, we ca conclude that resonance won't occur and linear analysis is sufficient to our case.

Lateral & Torsional Stiffness Analysis of Trunk Lid

Analysis is performed by midas NFX linear static analysis. The results are shown in the pictures below.



Displacement distribution
- Lateral stiffness



Displacement distribution
- Torsional stiffness

Results show distribution of lateral and torsional displacement. Stress can also be indentified with the software.