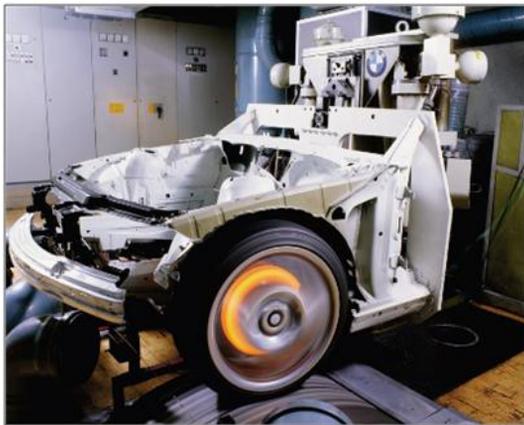




Brake disc coning (thermal deformation) analysis

Introduction of vehicle thermal deformation test

During deceleration of automobile, Kinetic energy of brake disk and pad is converted into thermal energy due to friction. The excessive rise of temperature can cause performance-degrading. Meanwhile, hot judder will occur in case of improper deformation in the disk itself. This not only causes noise and vibration of the braking system, but also cause thermal cracking due to repetitive thermal stress. Therefore, test is necessary to investigate temperature rises and thermal deformation of the brake disc.



Dynamometer test

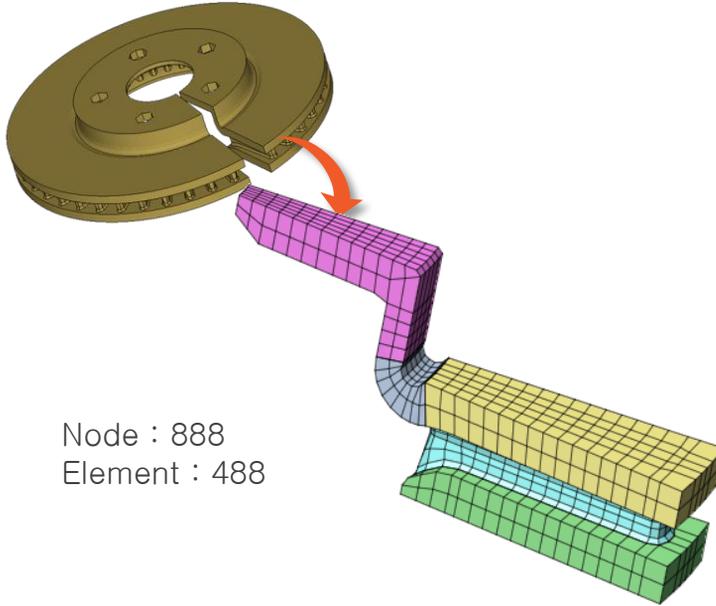


Vehicle test

Above pictures shows vehicle test. The test measures thermal deformation of the brake disc during velocity decrease from car's maximum speed to stop position.

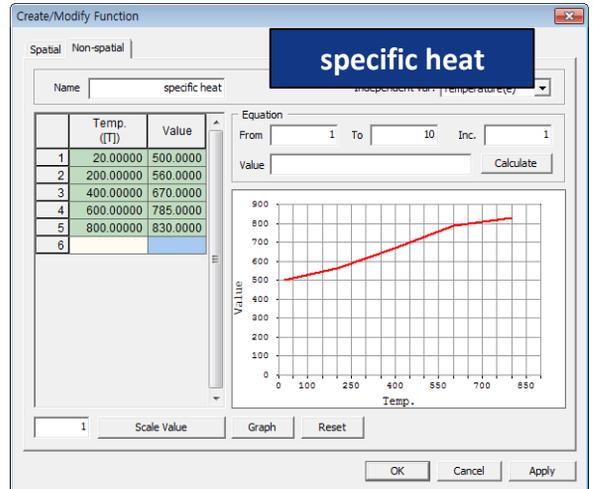
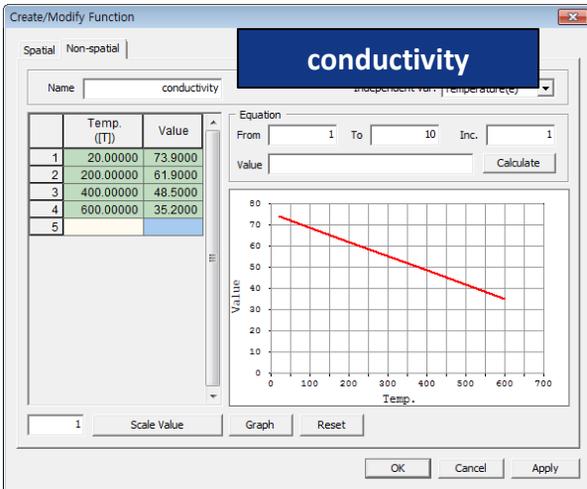


Modeling of brake disk

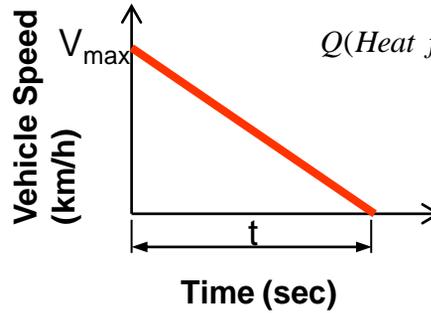


Node : 888
Element : 488

Name	Brake Disc
Elasticity modulus (N/mm²)	115000
Poisson's ratio	0.28
Coefficient of thermal expansion	1.32e-5
Density (kg/m³)	7150

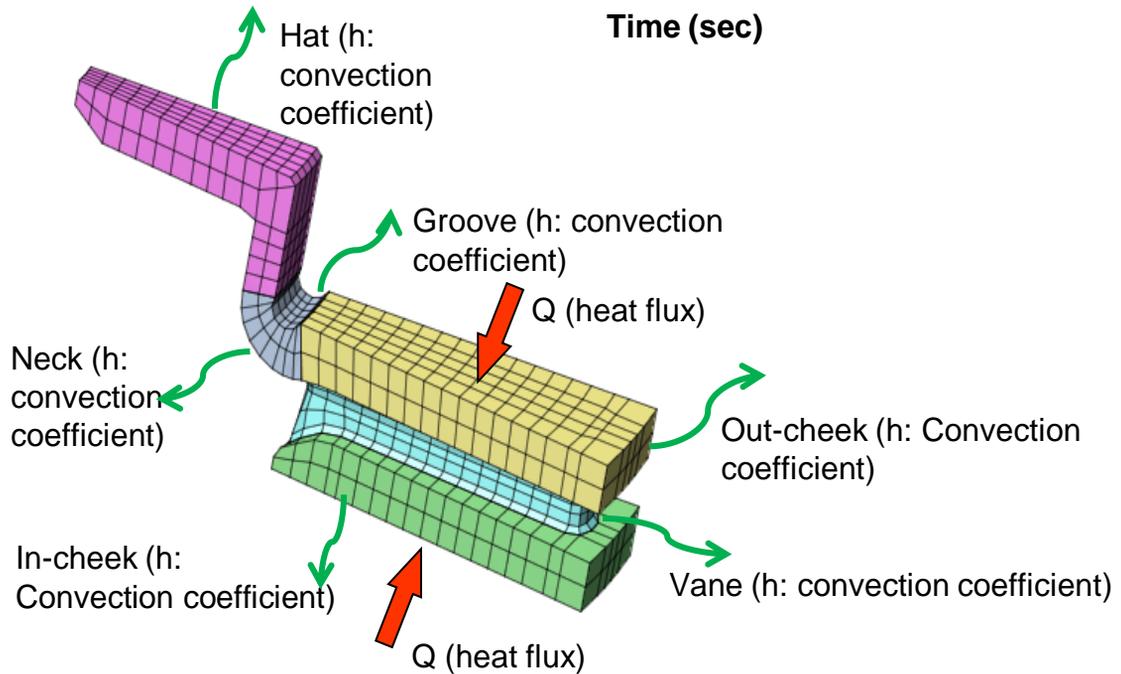


Since the model is axisymmetric, we only need to consider the part which contains one vane to simplify the model. The final modal contains 888 nodes and 488 elements. The material is assigned as cast irons.



$$Q(\text{Heat flux}) = \frac{\text{Power}}{\text{Pad swept area}}$$

$$E = \frac{1}{2} I \omega^2, \text{Power} = \frac{E}{t}$$

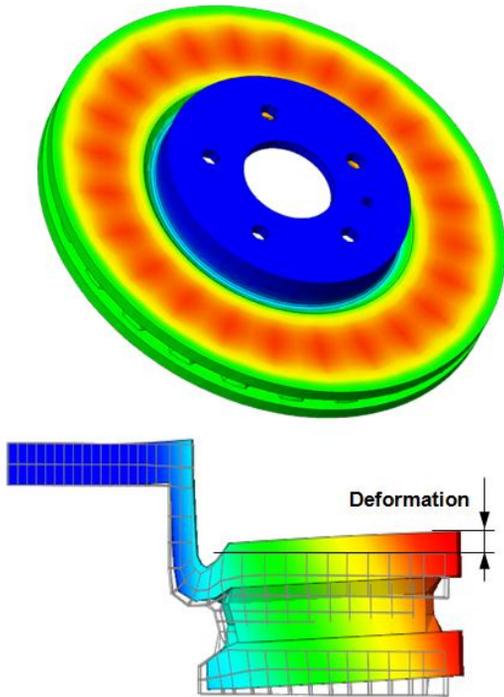


Above picture shows boundary conditions assigned to the model. On the cutting section we apply thermal gradient condition, and for the rest section of the model nodal temperature condition is applied.

Thermal energy generated during braking process from maximum speed to stop position is applied to the disk with the above formula.



Brake Disc Coning (thermal deformation) analysis



The final temperature and deformation results

Temperature	Deformation
423°C	0.702mm

Above results are performed by midas NFX thermal stress analysis.

Temperature and deformation distribution can be observed. Final temperature and deformation of the brake disc is 423 °C and 0.702 mm.