Contact Boundary Modeling Based on Pressure-Dependent Surface Stiffness

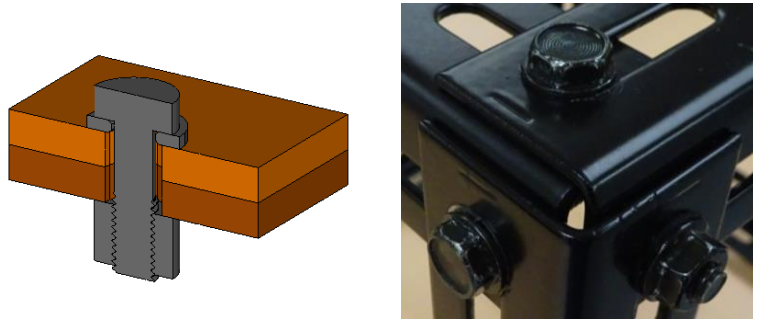
- Overview -

AVES connects contact boundaries using pressure-dependent contact surface stiffness and performs vibration analysis.

Contact pressure distribution can be calculated using a highly reliable finite element program (AVES solver).

This is effective when modeling structures in which the contact boundaries have a large effect on vibration characteristics.

Bolted structures



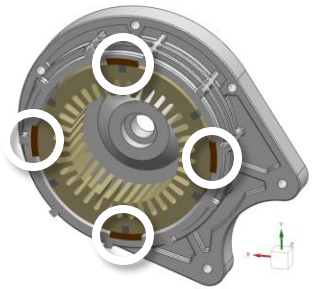
- Examples of use -

Bolted structures

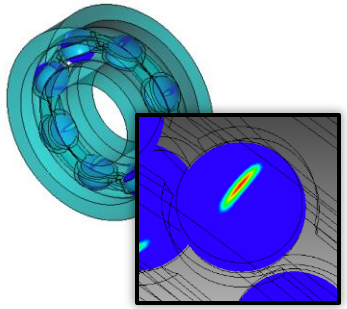
Fitting structures (Shrink fitting, etc.)

Other general contact boundaries

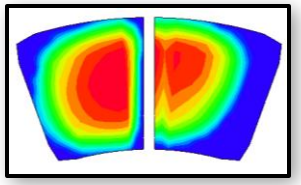
Fitting structures



Other general contacts



Ball contacts



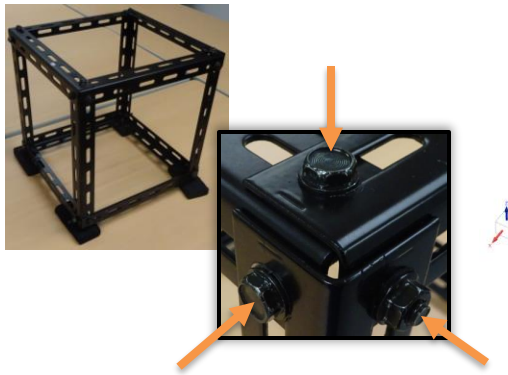
Friction surface of brake

Contact Boundary Modeling Based on Pressure-Dependent Surface Stiffness

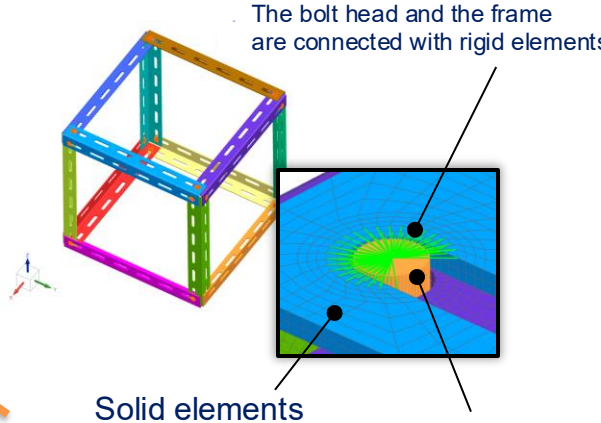
- Eigenvalue analysis of bolted frame structure -

● Overview of test piece and FE model

- The eight corners are joined by three bolts each.
- The frames and bolts are modeled with solid and beam elements, respectively.
- The material properties of the frame have been correlated in advance.
- In the contact analysis, contact conditions are defined between the frames, and axial force is applied to the bolts.

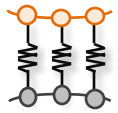


One bolt for each direction



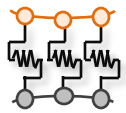
● Pressure to stiffness conversion

- The contact pressure distribution obtained by contact analysis is converted into the contact surface stiffness distribution between the frames.



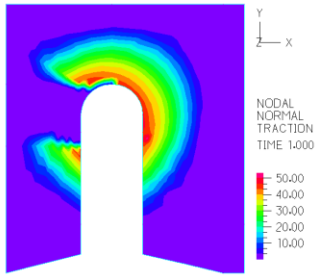
Normal direction

$$k_{\mathrm{N}} = Ap^{B}$$



Tangential direction

$$k_{\mathrm{T}} = Cp^{D}k_{\mathrm{N}}$$



Contact pressure distribution

Conversion parameters A to D are calculated based on the surface roughness.

● Vibration analysis results considering contact surface stiffness

- Under all three conditions with different tightening torques, the error from the measurement was less than 5%.

Comparison of experiments and analysis under different fastening force conditions

Mode	Torque 2.6 Nm			Torque 5.2 Nm			Torque 7.8 Nm		
	EXP	AVES		EXP	AVES		EXP	AVES	
	Frequency [Hz]	Frequency [Hz]	Error [%]	Frequency [Hz]	Frequency [Hz]	Error [%]	Frequency [Hz]	Frequency [Hz]	Error [%]
1	243	238	**-2.10%**	253	251.6	**-0.60%**	256	259.4	**1.30%**
2	256	243.6	**-4.80%**	267	256.1	**-4.10%**	270	263.1	**-2.60%**
3	319	318.3	**-0.20%**	332	331.7	**-0.10%**	335	338.9	**1.20%**