木橋の劣化診断のための振動解析の精度について

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提供：函館工業高等専門学校

木橋･･･劣化

↑

砂袋落下試験･･･非破壊診断

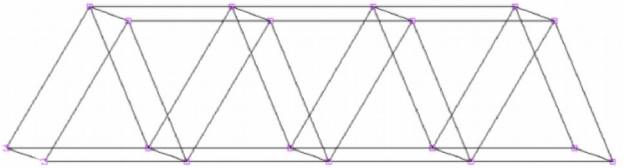
固有振動数

⋮

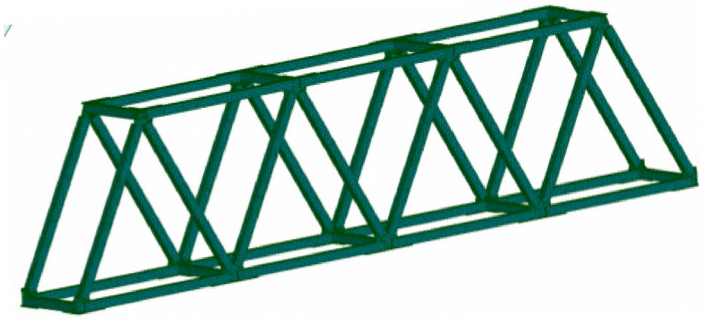
剛性や強度と相関が高い

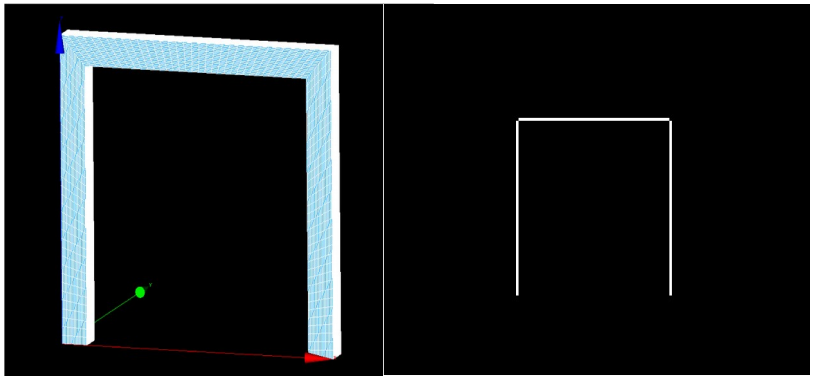
モード解析

梁要素モデル（近似）

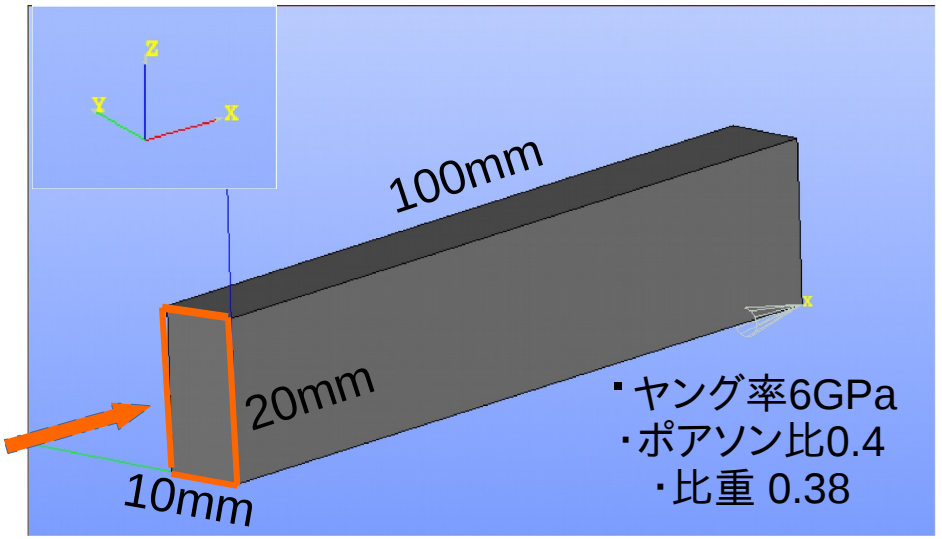


四面体要素モデル（理想）

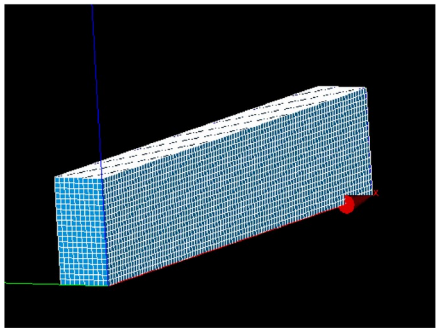




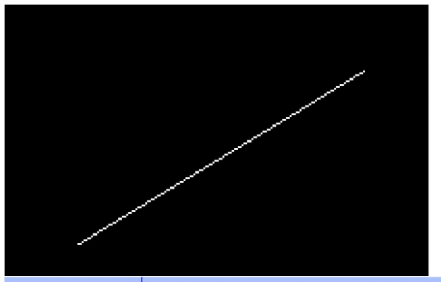
片持ち梁（振動解析 Salome-Meca）

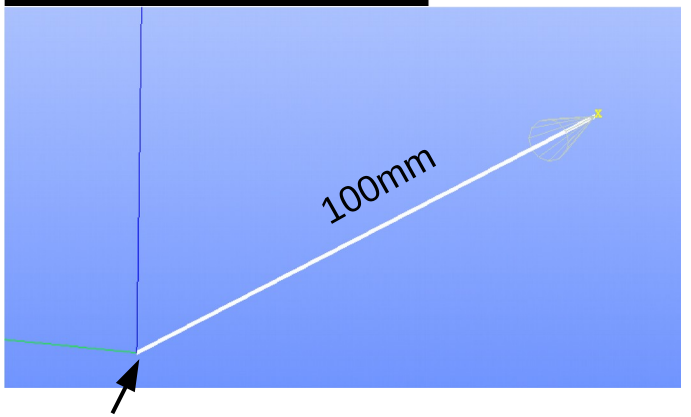


四面体要素

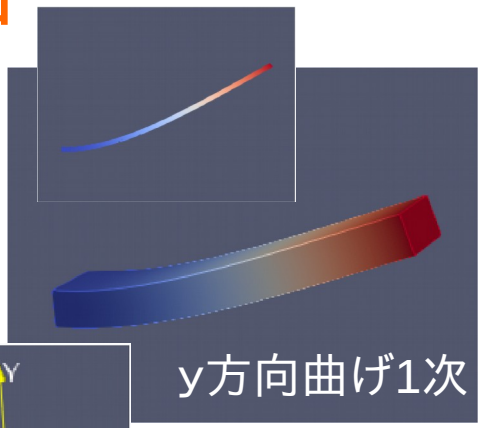


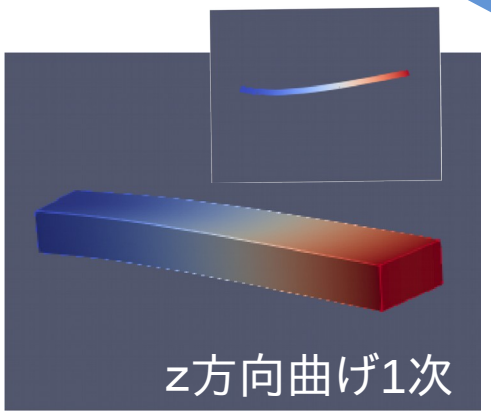
梁要素

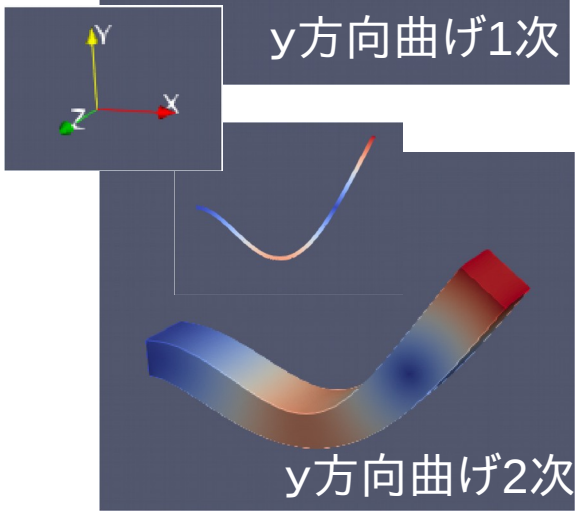


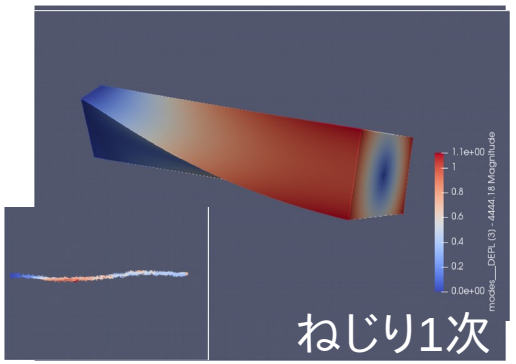


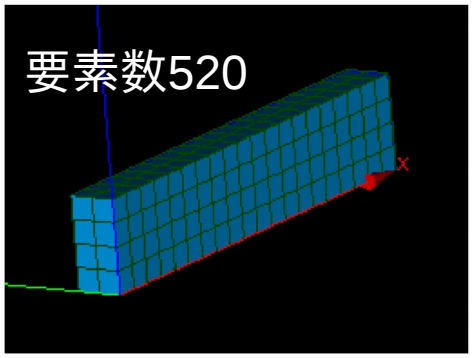
20mm×10mmの矩形断面として設定し、計算

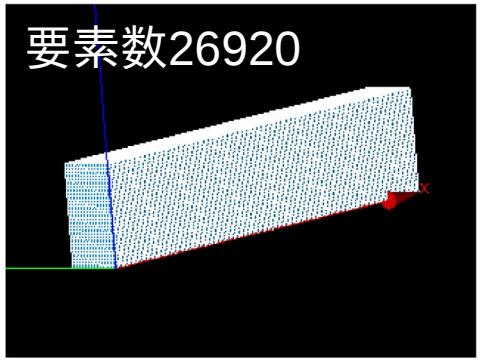


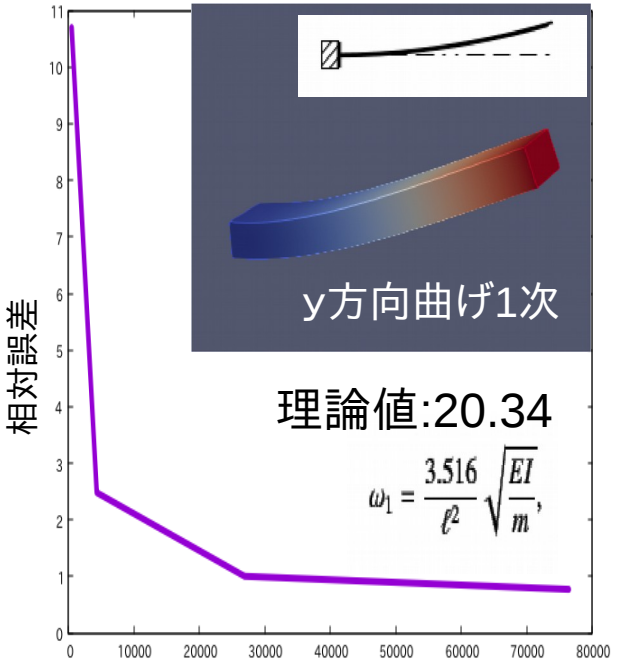


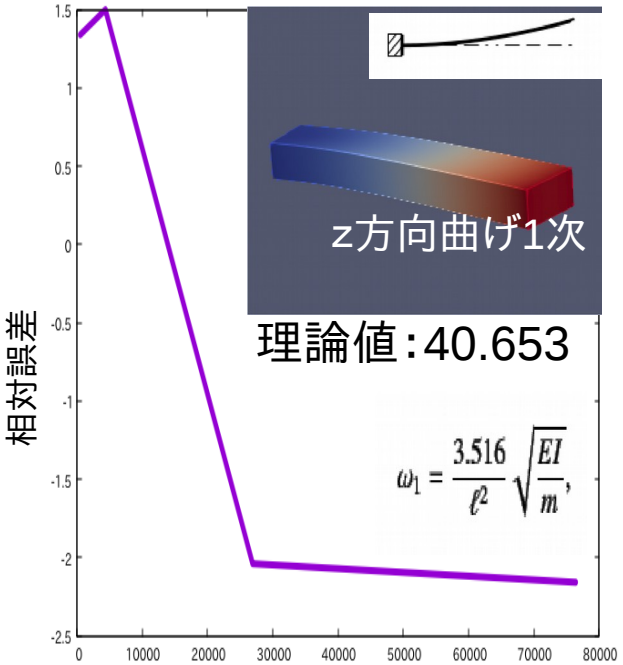








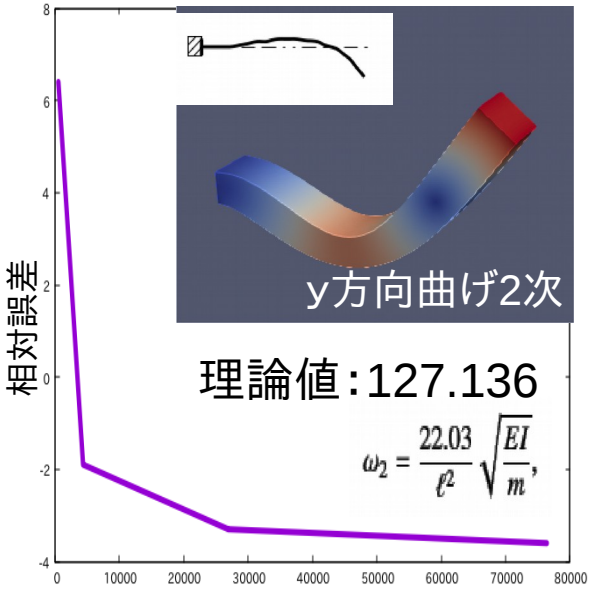


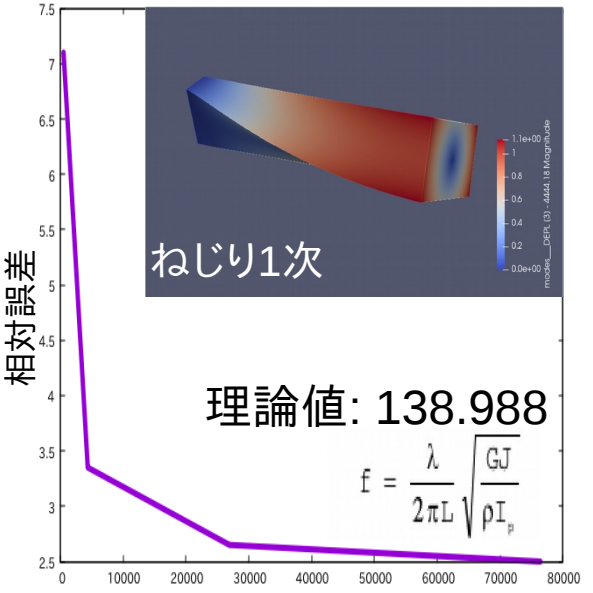


1次

2次

曲げモード	梁要素 要素数730	四面体要素
y方向曲げ1次	20.299 (0.2%)	20.554 (1.05%)
z方向曲げ1次	40.597 (0.14%)	39.823 (2.042%)
y方向曲げ2次	127.209 (0.057%)	122.908 (3.326%)
ねじり1次	139.142 (0.11%)	142.669 (2.648%)

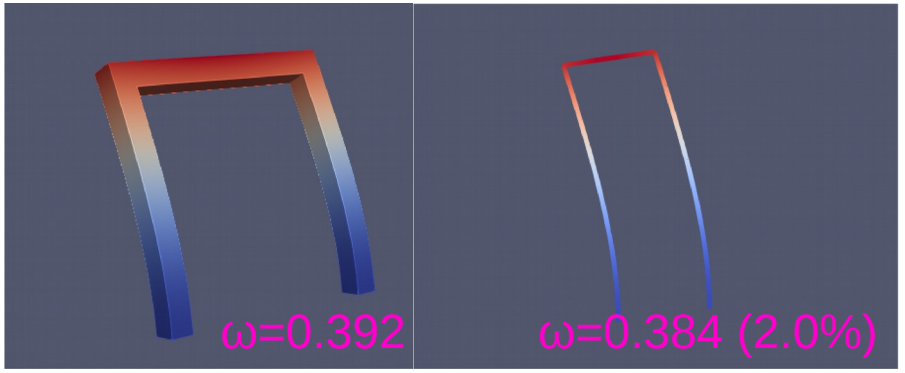




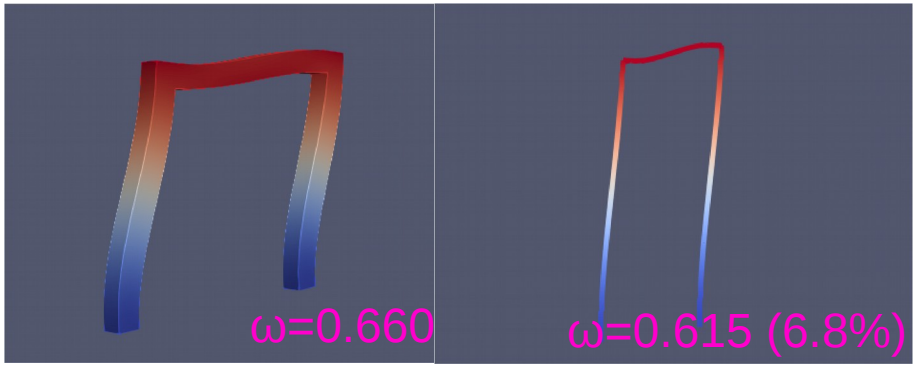
300mm×300mm×3mのラーメン構造

$$\frac{\text{部材長}}{\text{部材幅}}=10$$

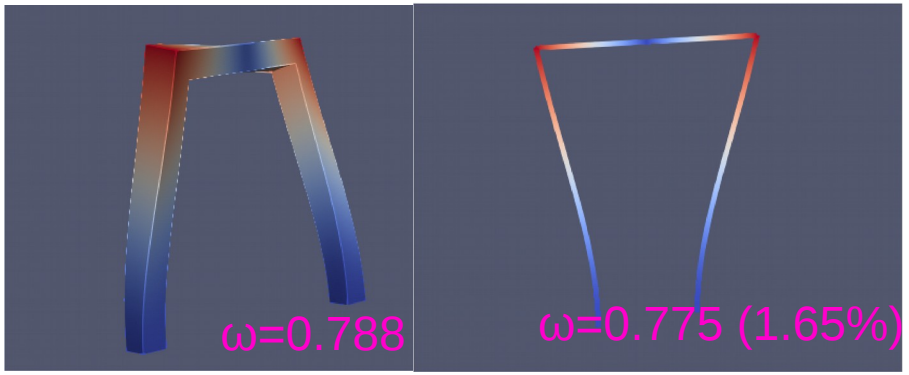
面外曲げ1次



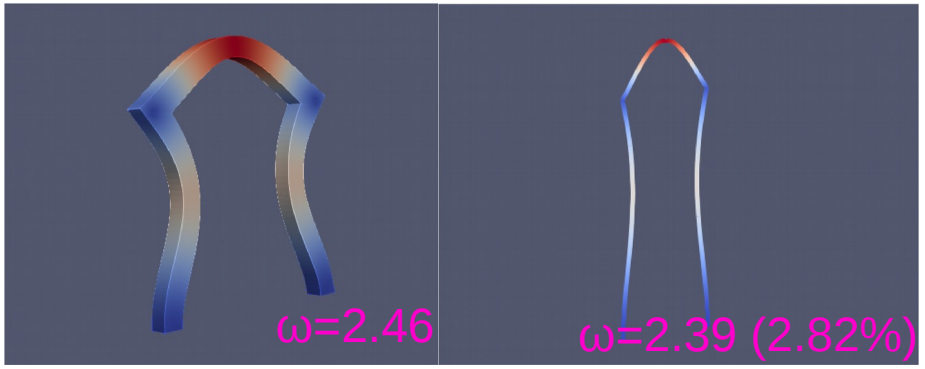
面内曲げ1次



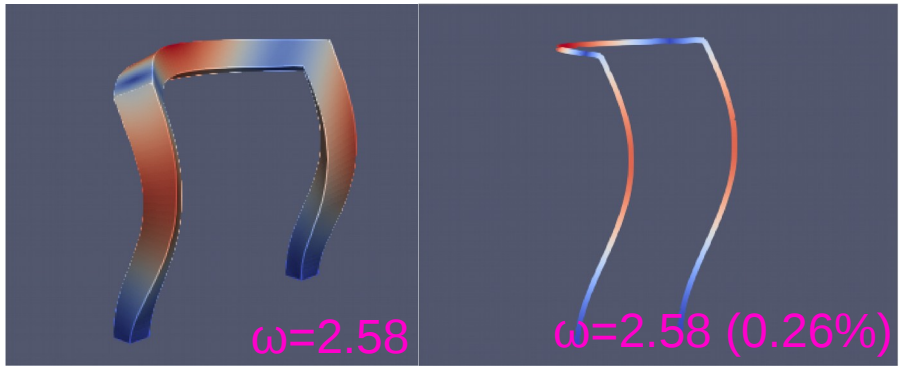
全体ねじれ1次

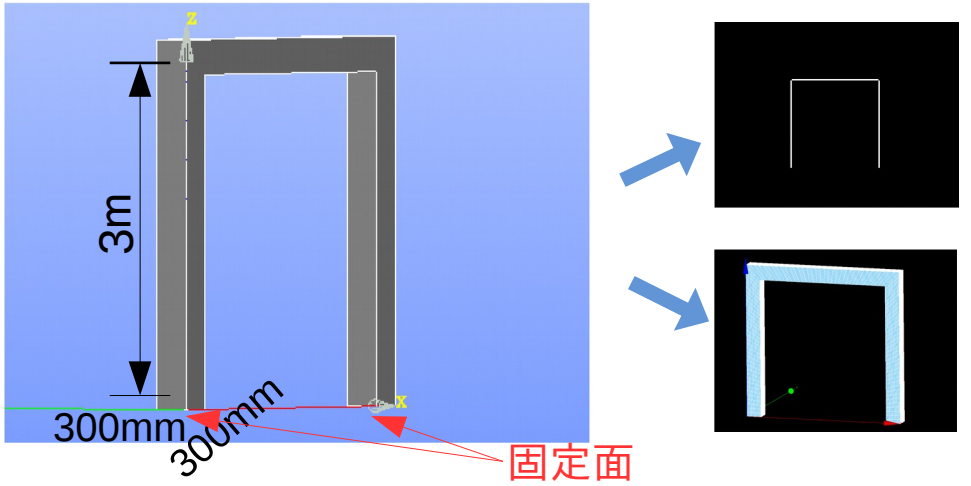


面内曲げ2次



面外曲げ2次

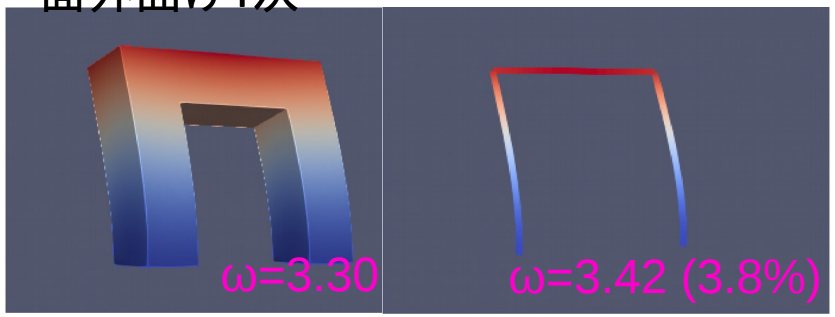




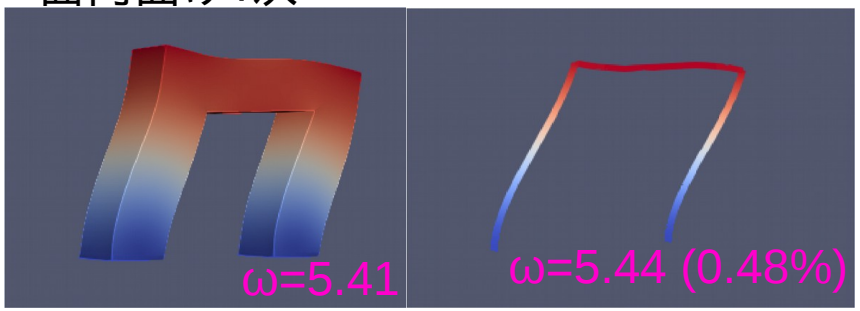
300mm×300mm×1mのラーメン構造

$\frac{\text{部材長}}{\text{部材幅}}$ =3.33

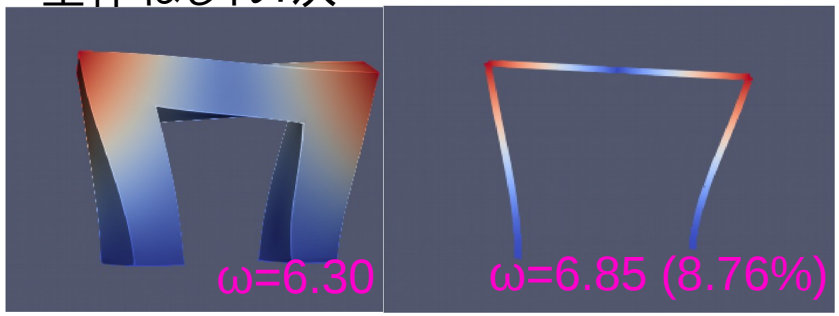
面外曲げ1次



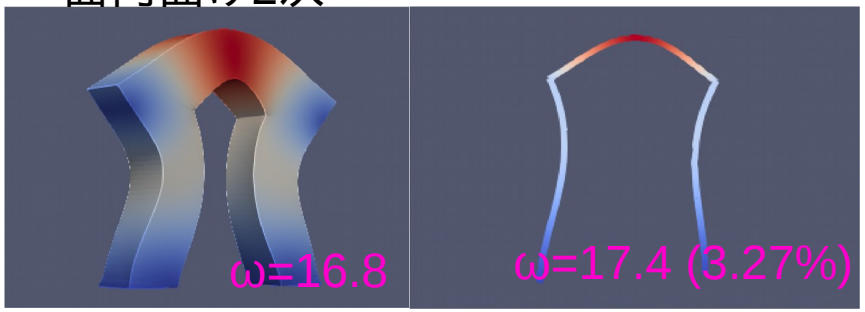
面内曲げ1次



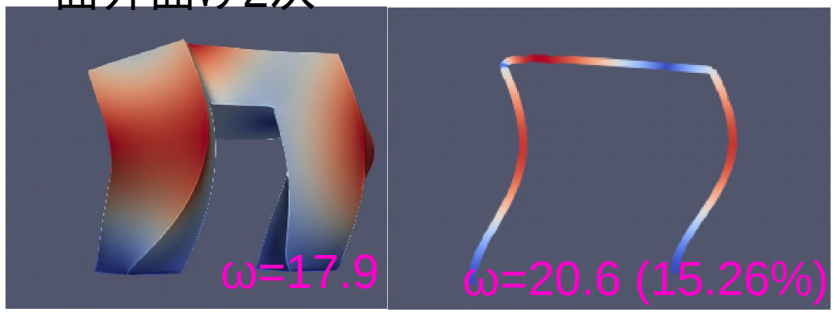
全体ねじれ1次

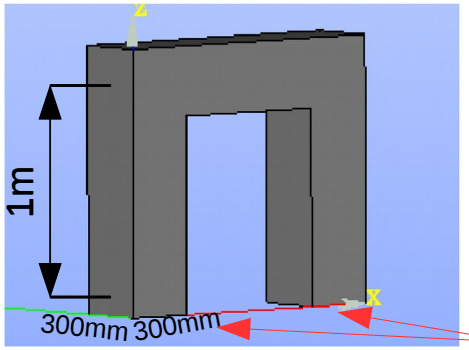


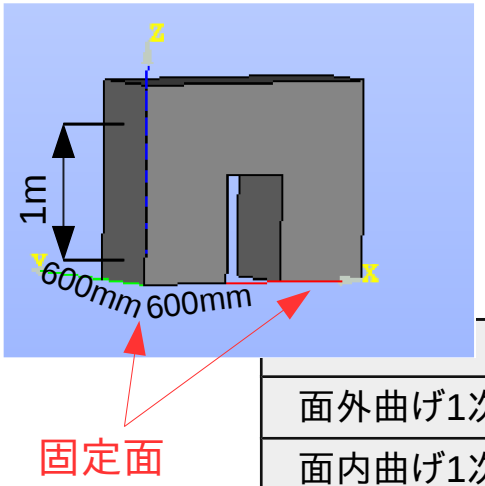
面内曲げ2次



面外曲げ2次







600mm×600mm×1m
のラーメン構造

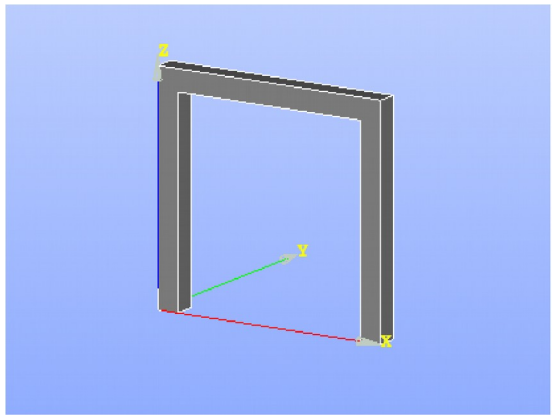
$\frac{\text{部材長}}{\text{部材幅}}$ =1.66

	四面体要素	梁要素
面外曲げ1次	5.644	6.629(17%)
面内曲げ1次	8.603	10.25(19%)
全体ねじれ1次	9.340	12.84(37%)
面内曲げ2次	21.31	20.57(3.5%)
面外曲げ2次	22.30	25.50(14%)

まとめ

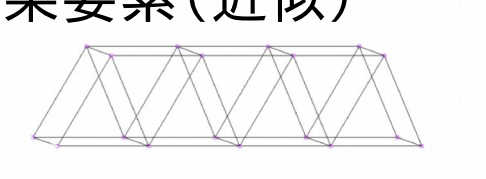
提供：函館工業高等専門学校

劣化診断
固有振動数

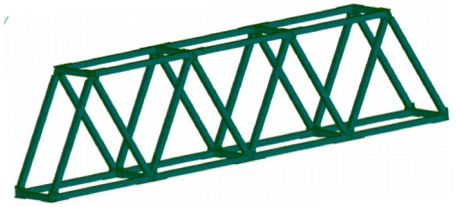


モード解析

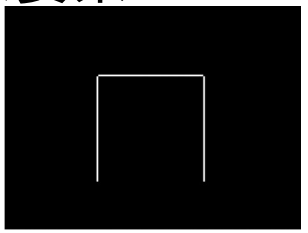
梁要素（近似）



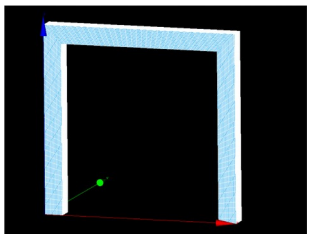
四面体要素（理想）



梁要素



四面体要素



$$\frac{\text{部材長}}{\text{部材幅}} = 10\text{程度なら梁要素でも十分}$$

$$\frac{\text{部材長}}{\text{部材幅}} < 10 \text{ の場合} \rightarrow \text{四面体要素の方が正確}$$