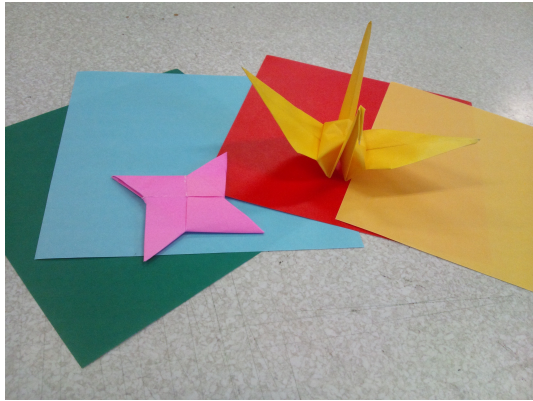


# ダイヤカット円筒のFEM解析におけるメッシュ依存性

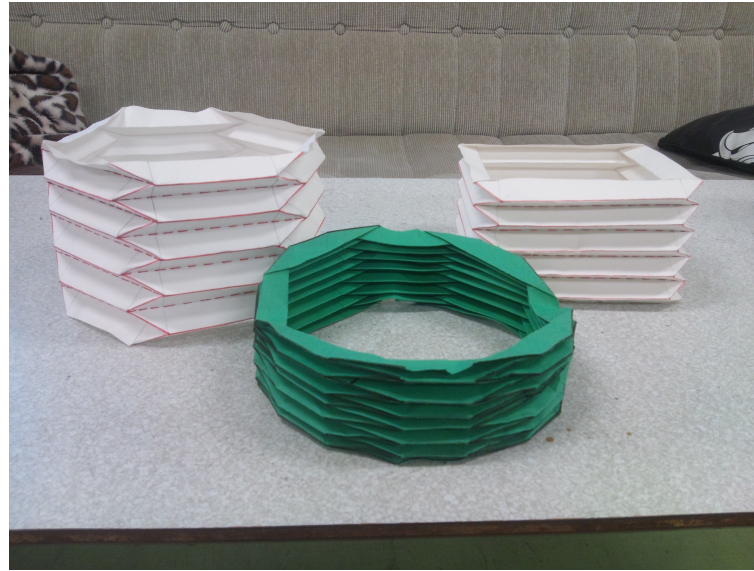
環境構造工学講座

7509705 井比 宏幸

折り紙構造とは



折り畳み機能・コンパクト

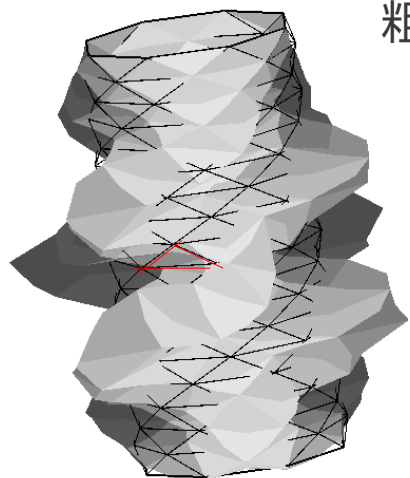


更にはばね性能も

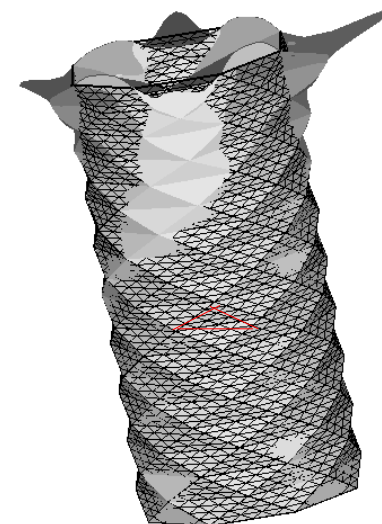


更に薄肉構造で高強度

しかし、複雑な構造……



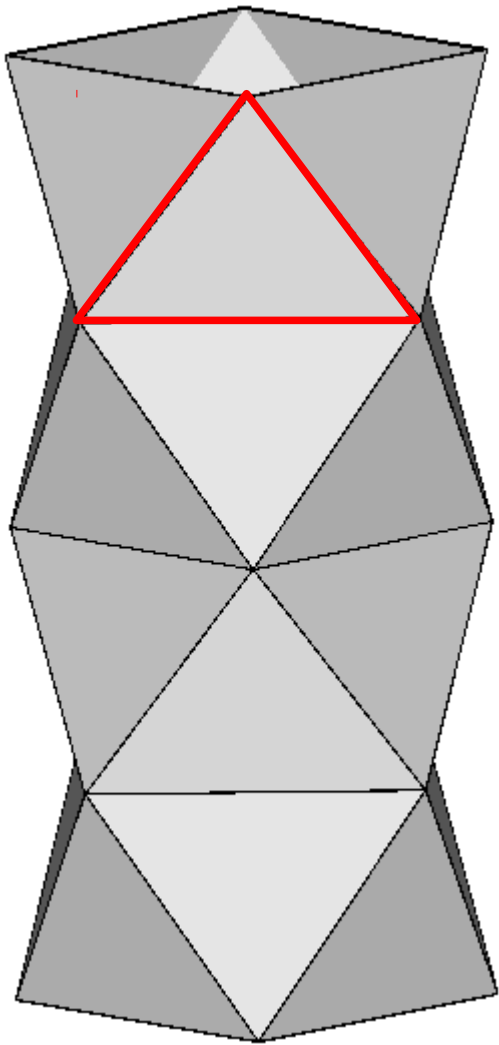
粗いメッシュ



細かいメッシュ

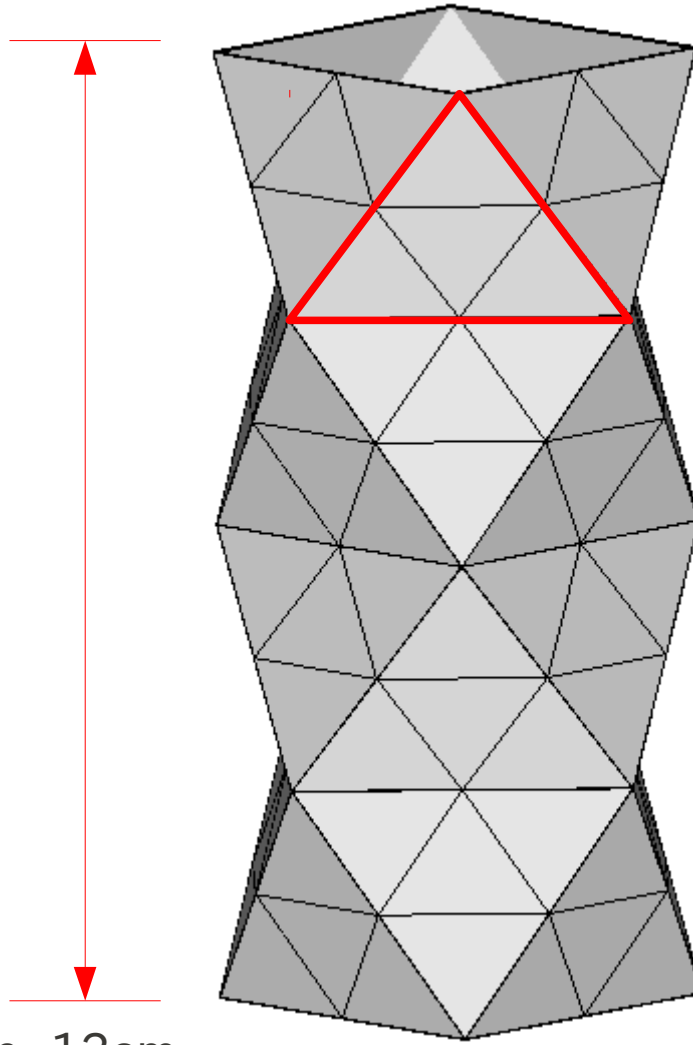
## メッシュ依存性

・解析モデル



1分割数

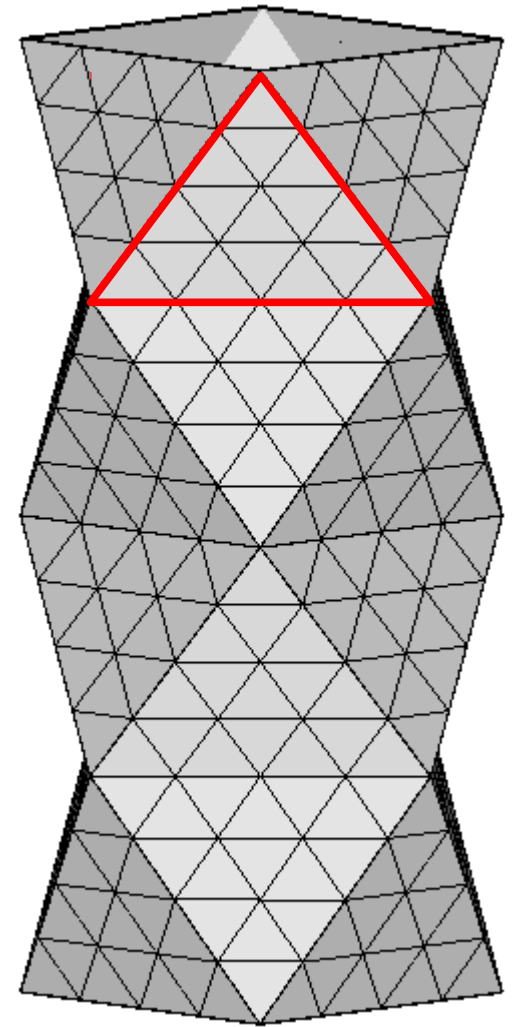
- ・半径=3cm
- ・厚さ=0.2mm



h=12cm

4分割数

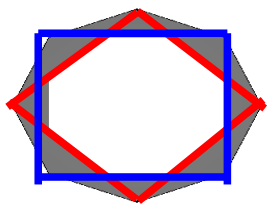
- ・ヤング率=69GPa
- ・荷重=100N



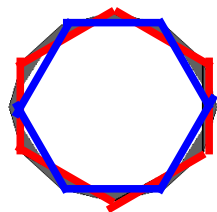
16分割数

有限要素解析ツール: Calculix

・周方向パターン数(4~20角形)



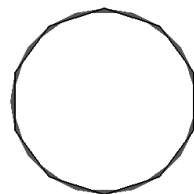
4角



6角

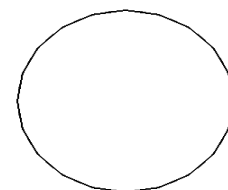


8角



10角

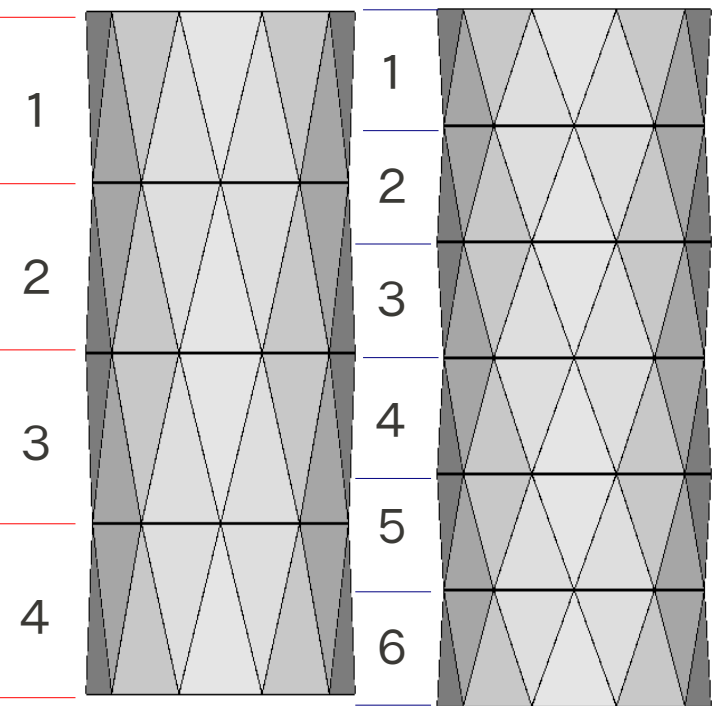
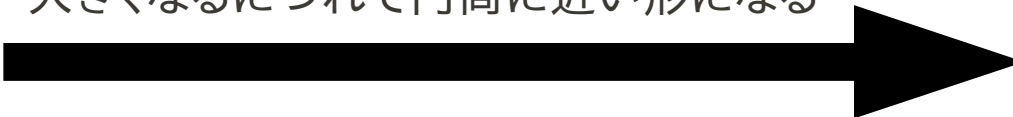
.....



20角

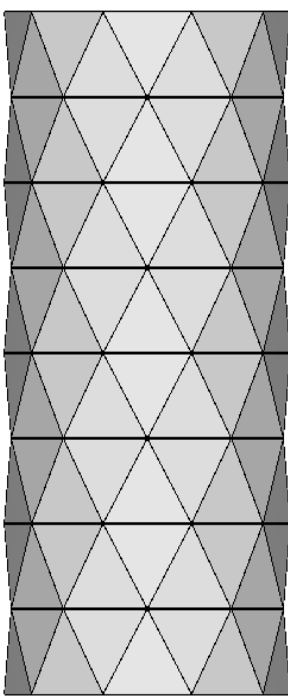
大きくなるにつれて円筒に近い形になる

・高さ方向パターン数(4~20段)

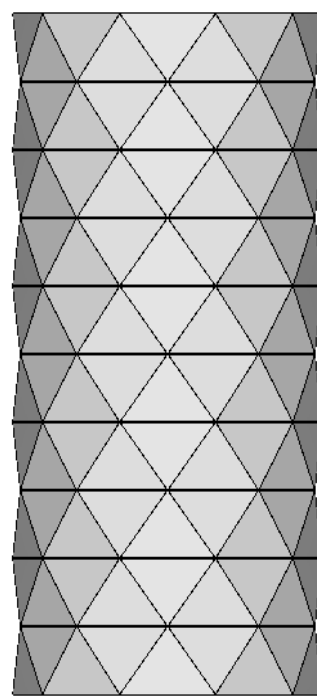


4段

6段

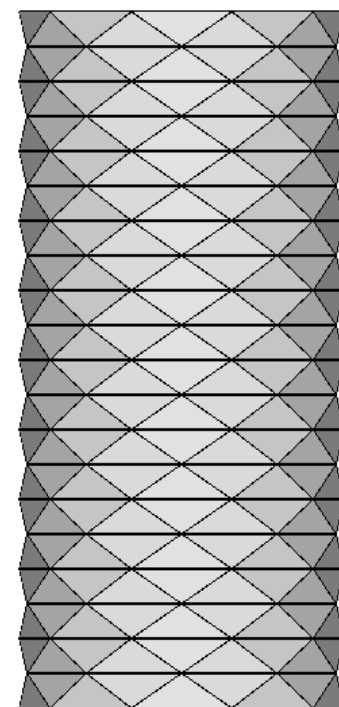


8段



10段

.....

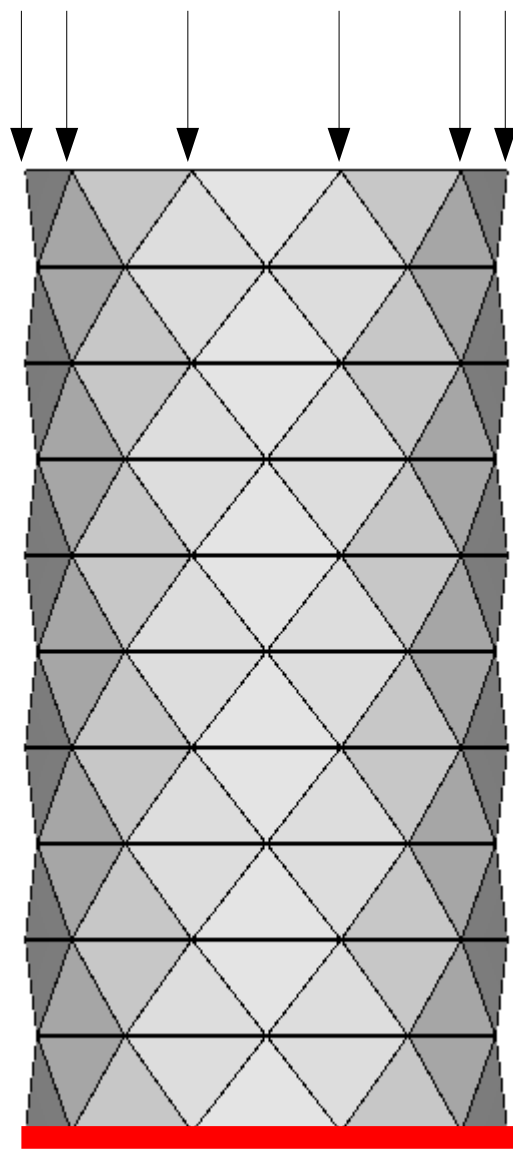


20段

・解析手法

載荷方法

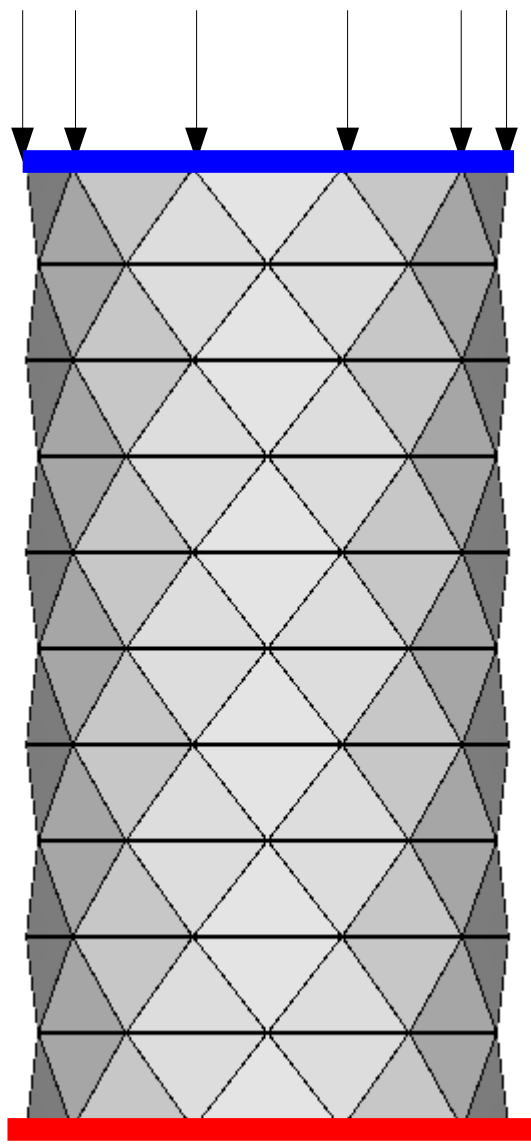
上端の全節点に均等に荷重をかける



ばね定数

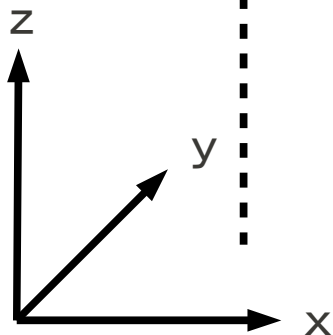
全節点拘束

載荷節点の水平方向を拘束



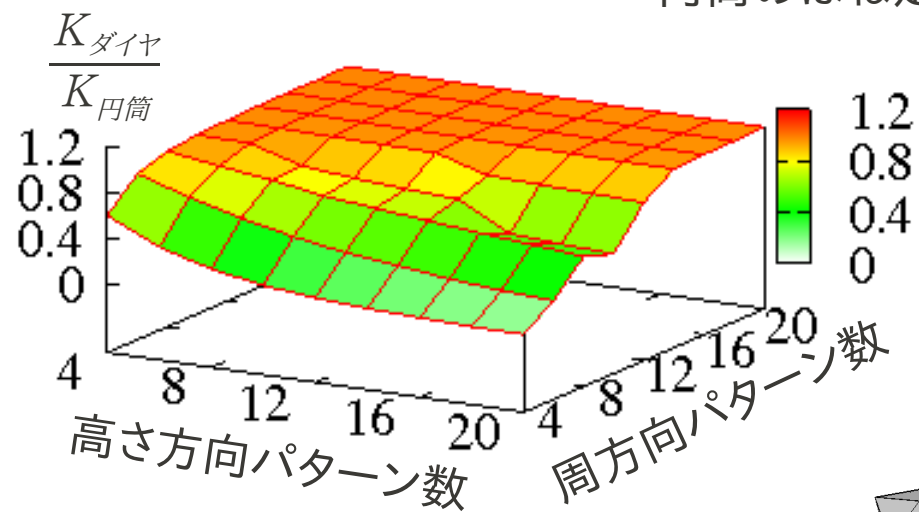
座屈荷重

全節点拘束

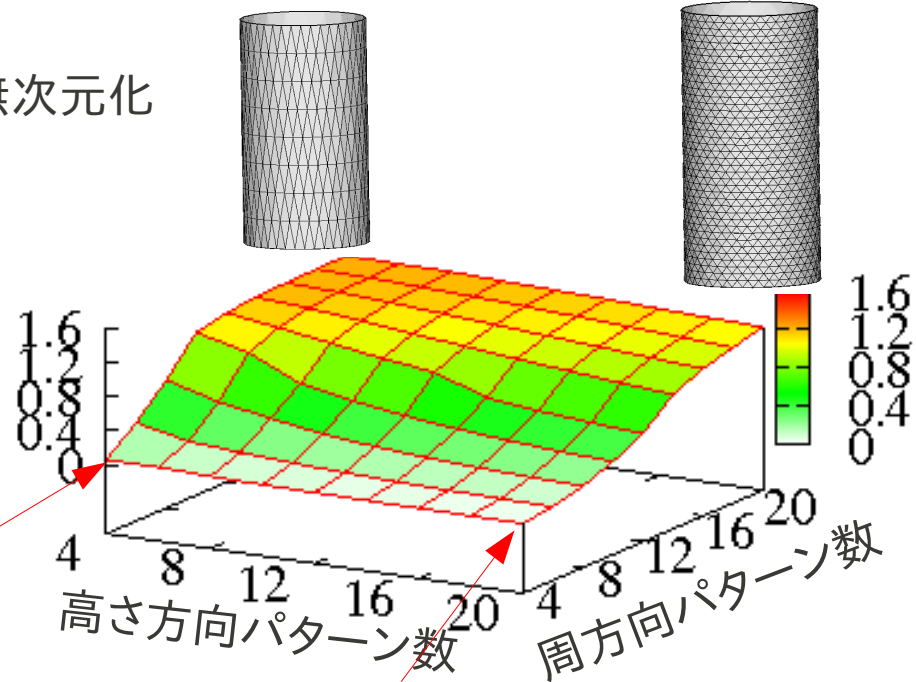


ばね定数の比較

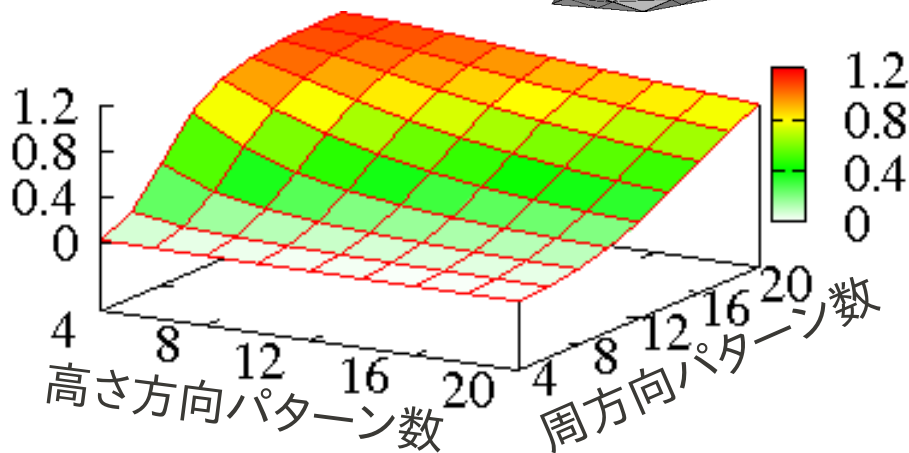
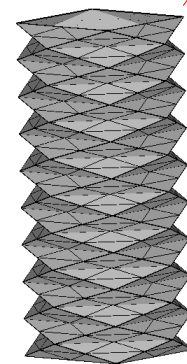
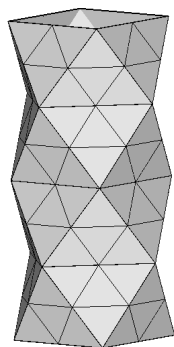
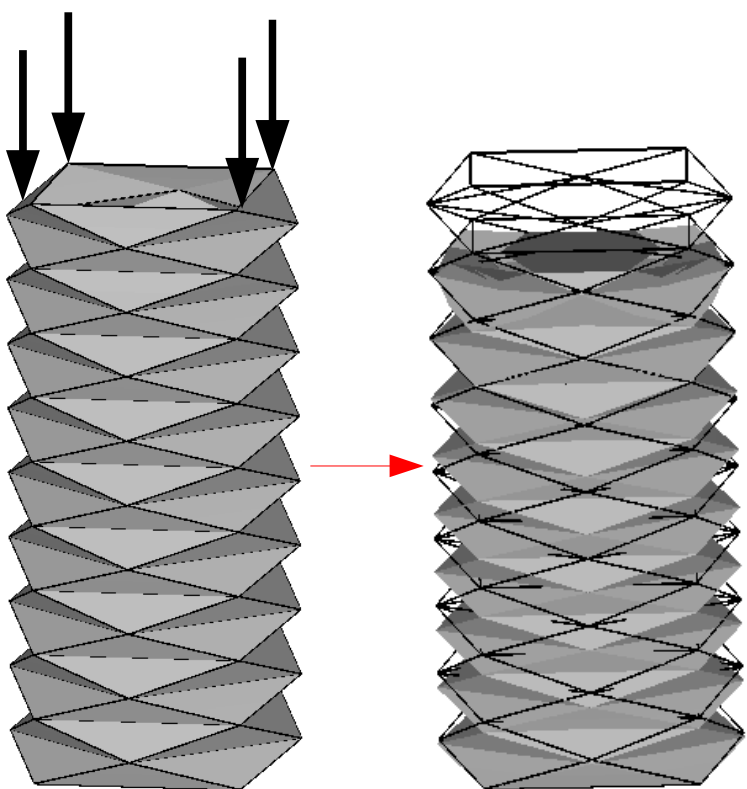
円筒のばね定数で無次元化



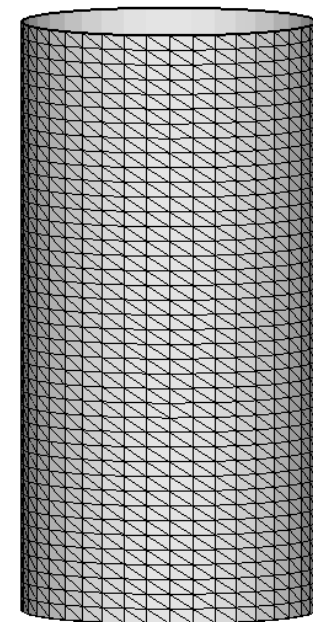
1分割



4分割



16分割

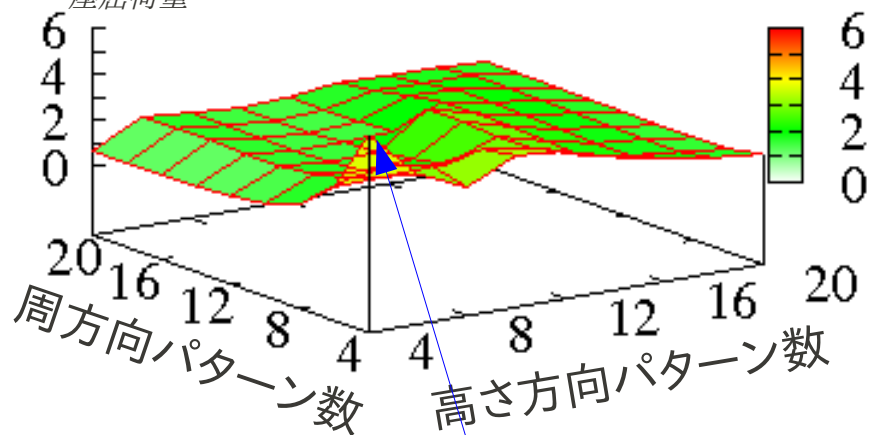


# ・座屈荷重の比較

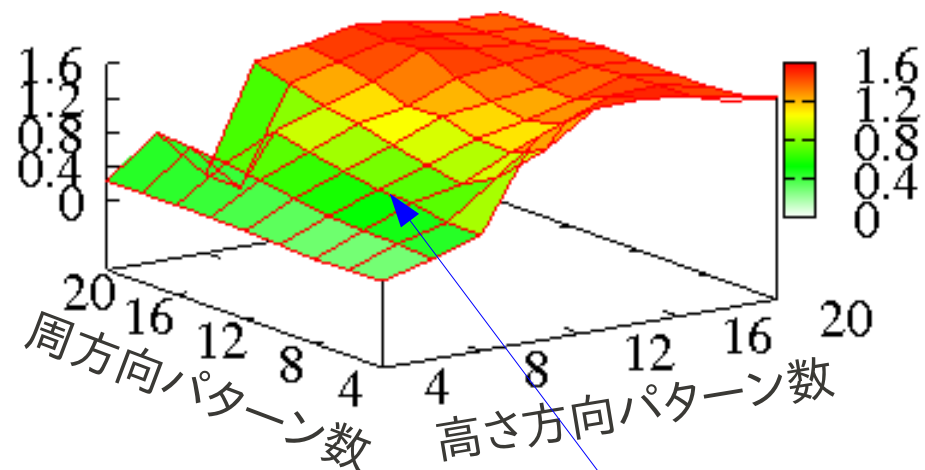
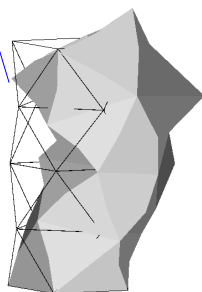
ばね定数と同じように円筒の座屈荷重で無次元化

ダイヤ座屈荷重

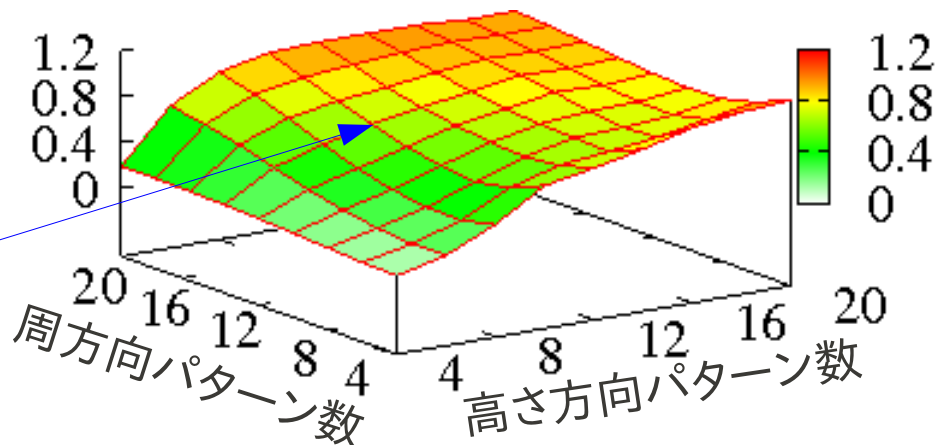
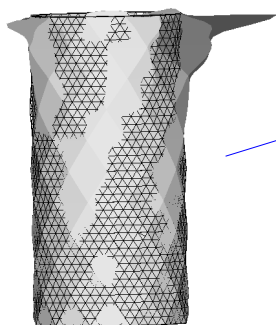
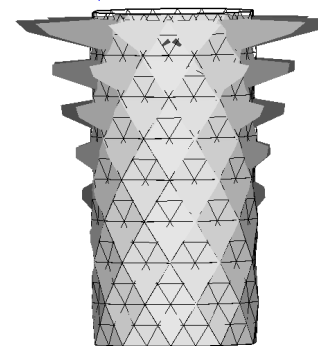
円座屈荷重



1分割



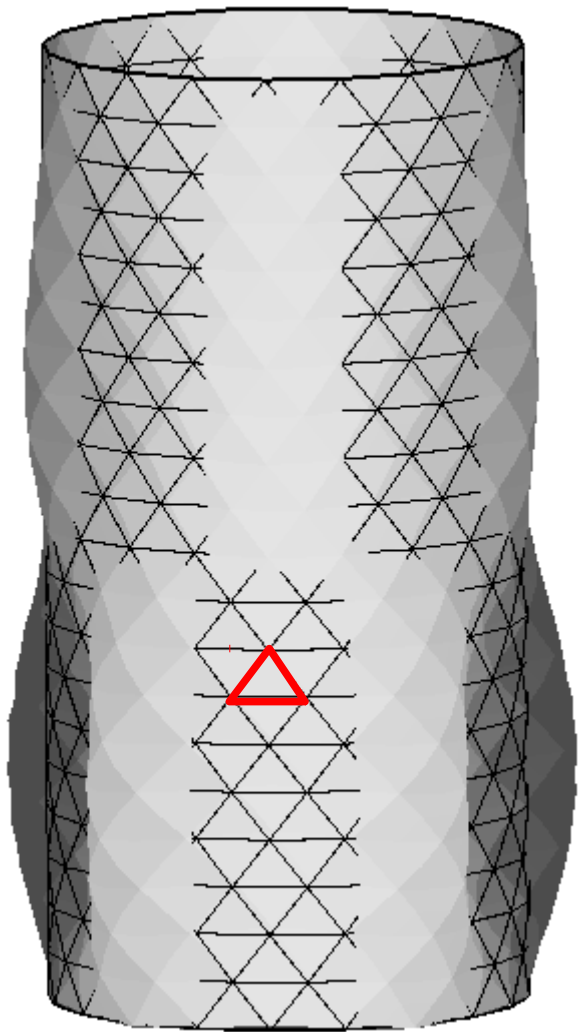
4分割



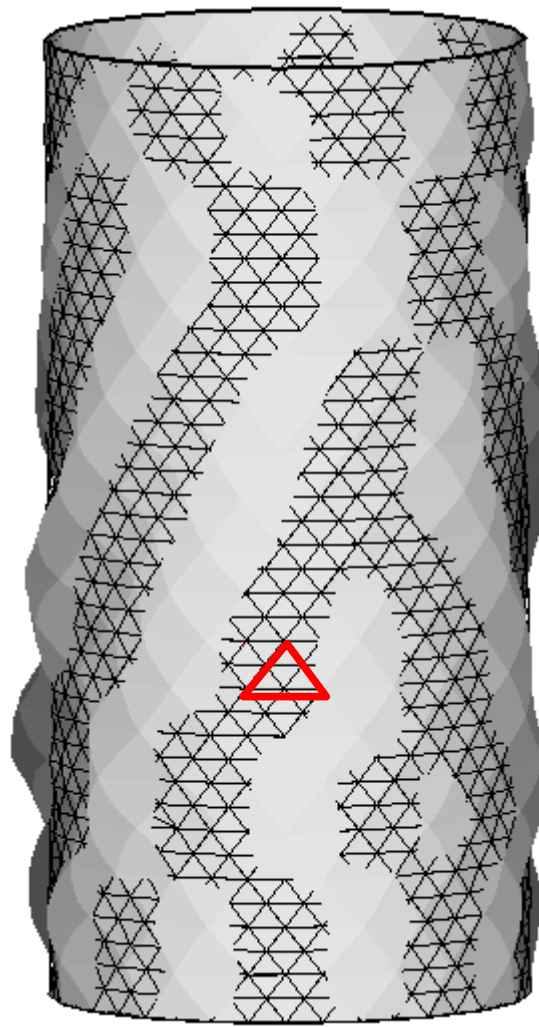
16分割

・座屈モード

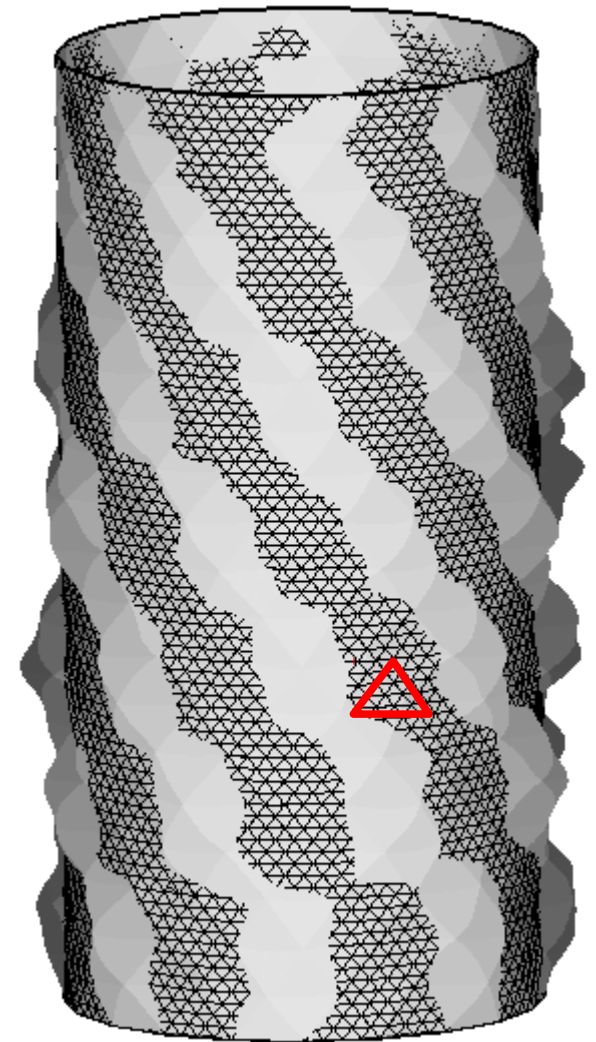
円筒に近い周方向パターン数20、高さ方向パターン数20での比較



1分割数



4分割数

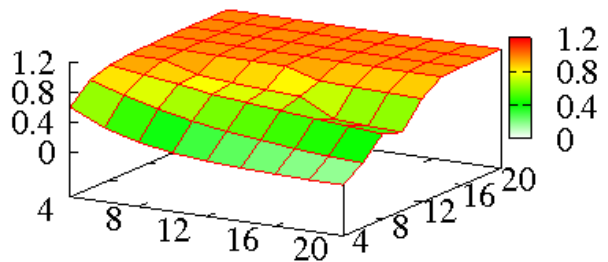


16分割数

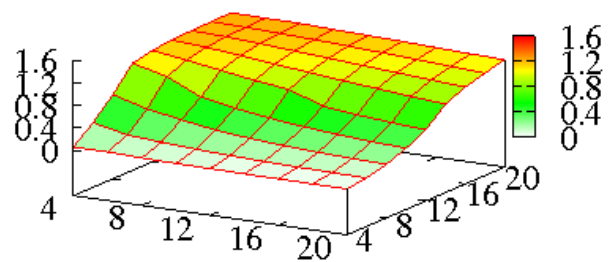
・まとめ

ばね定数

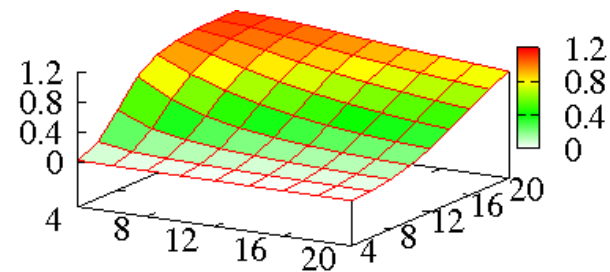
・1分割



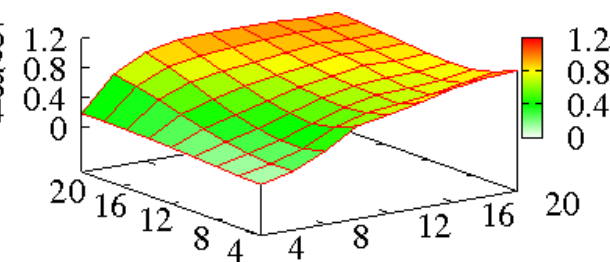
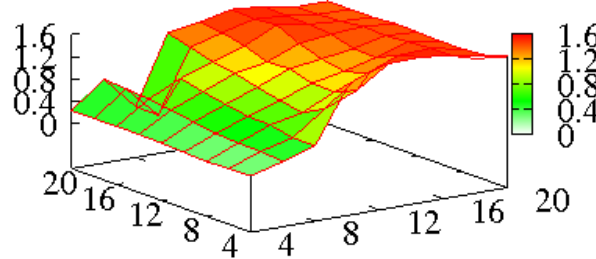
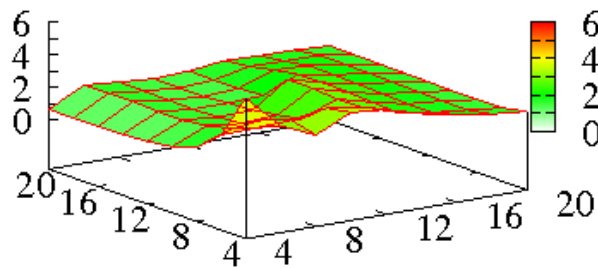
・4分割



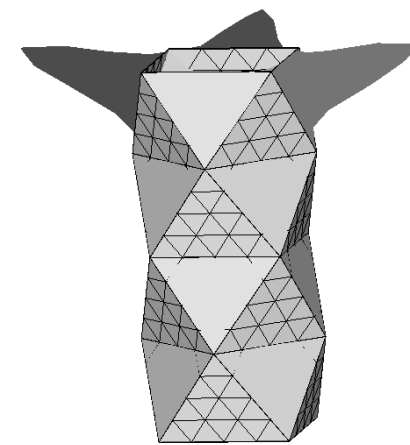
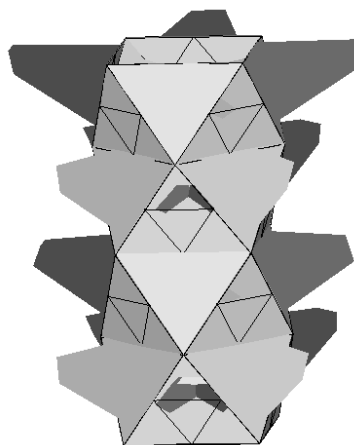
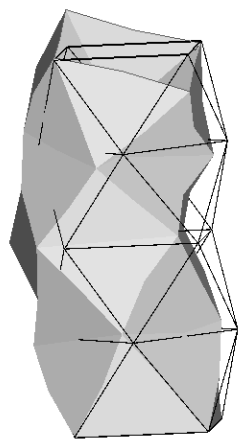
・16分割



座屈荷重



座屈モード



メッシュ依存性は認められる



$$P_{\text{座屈荷重}} = \frac{2 \pi E t^2}{\sqrt{3(1-\nu^2)}}$$