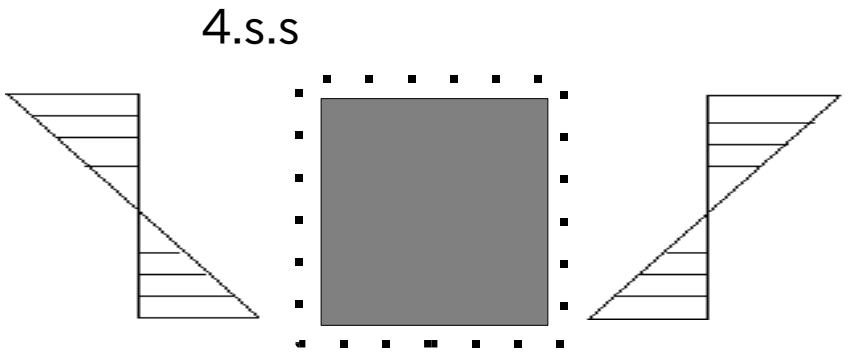
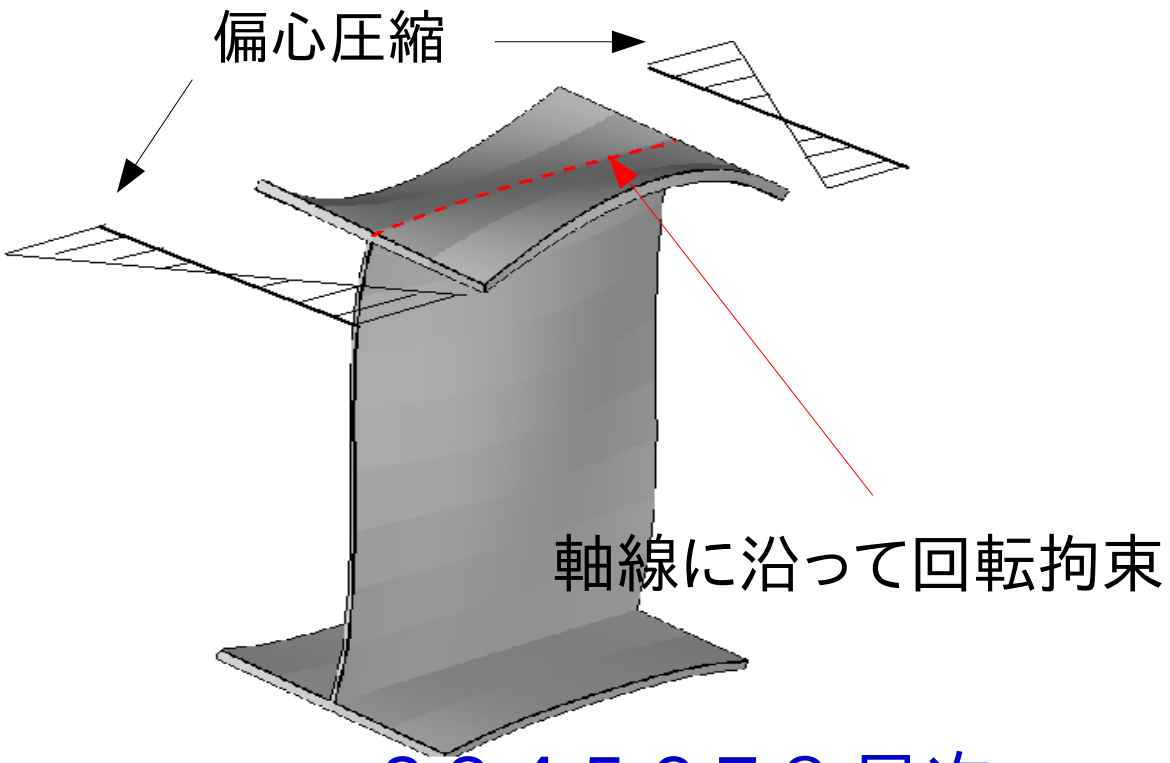
偏心載荷を受ける I型梁圧縮フランジの座屈

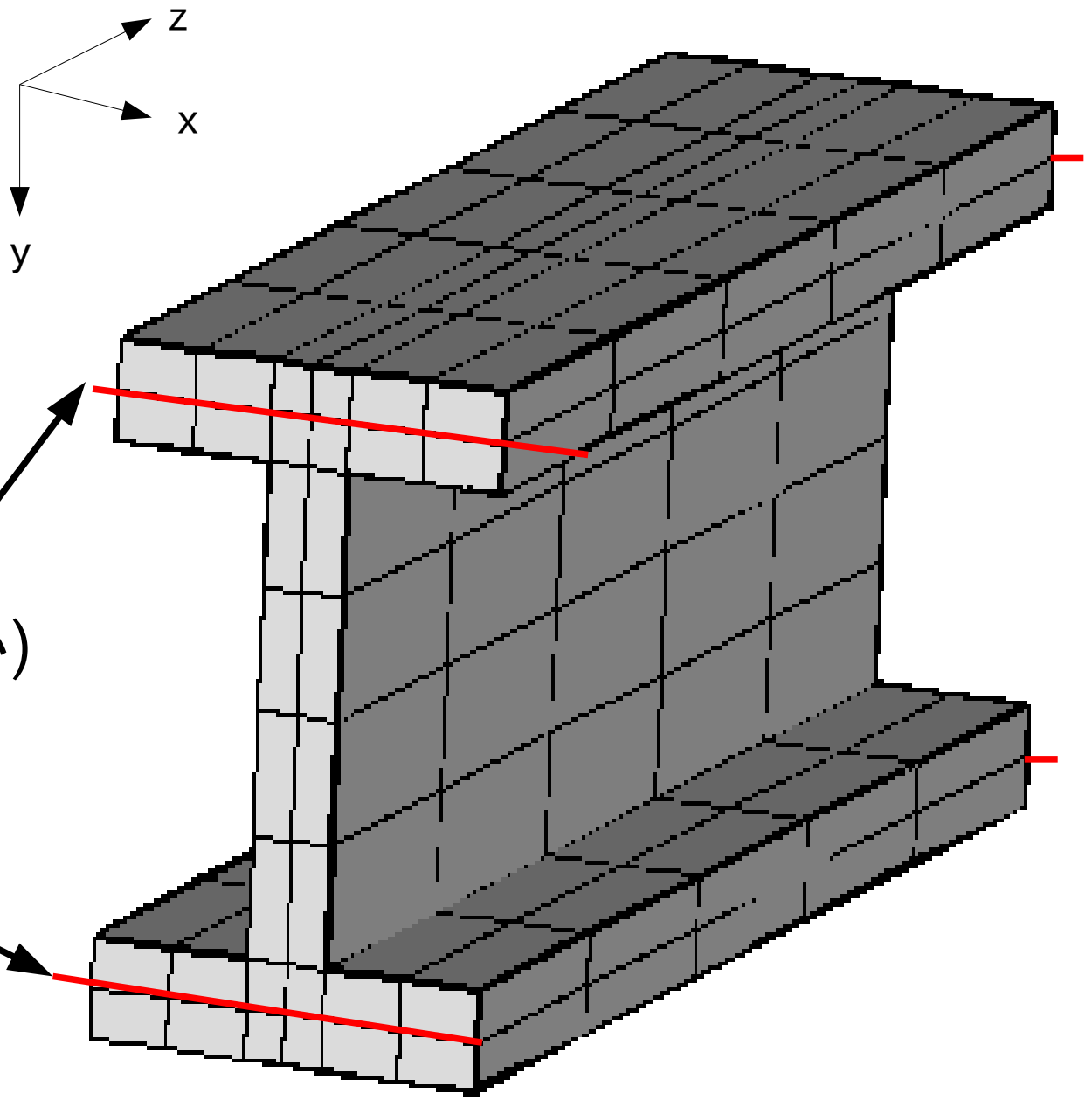
環境構造工学講座
04477 山崎 由紀子

はじめに





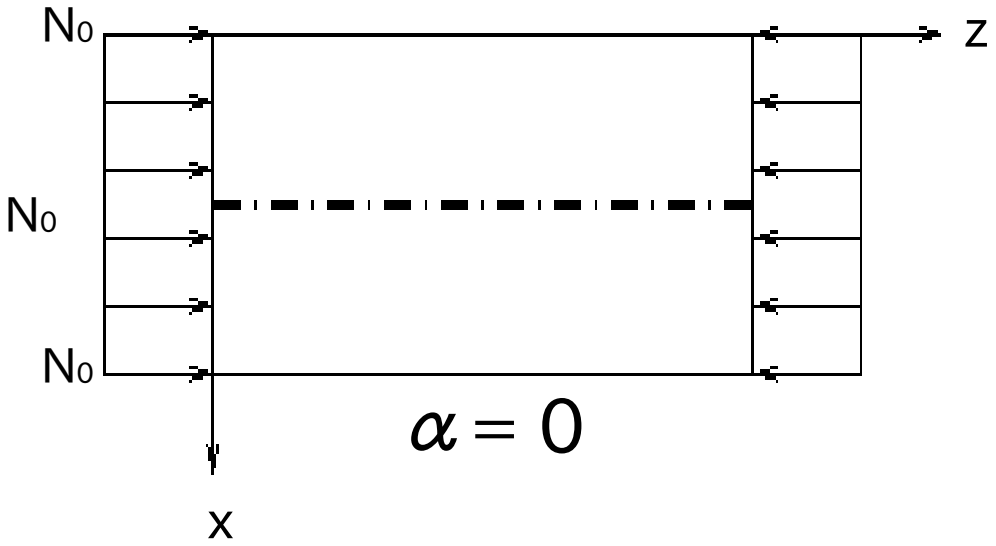
境界条件



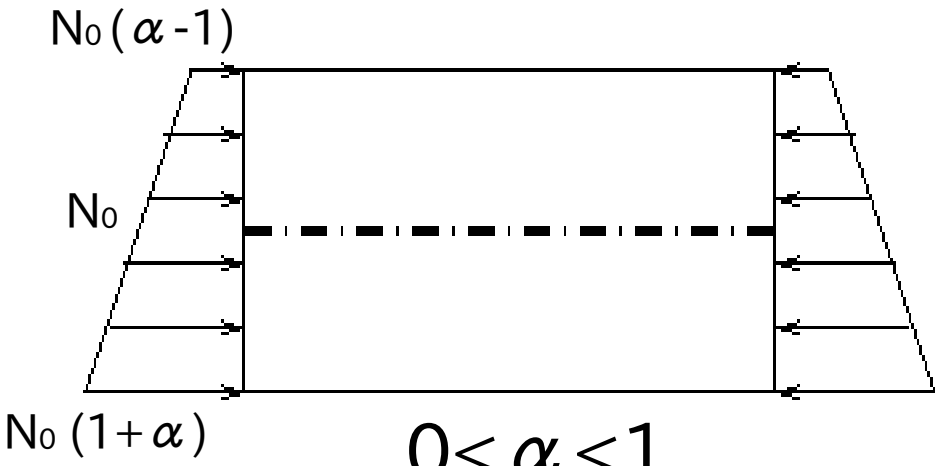
解析ツール
CalculiX

載荷方法

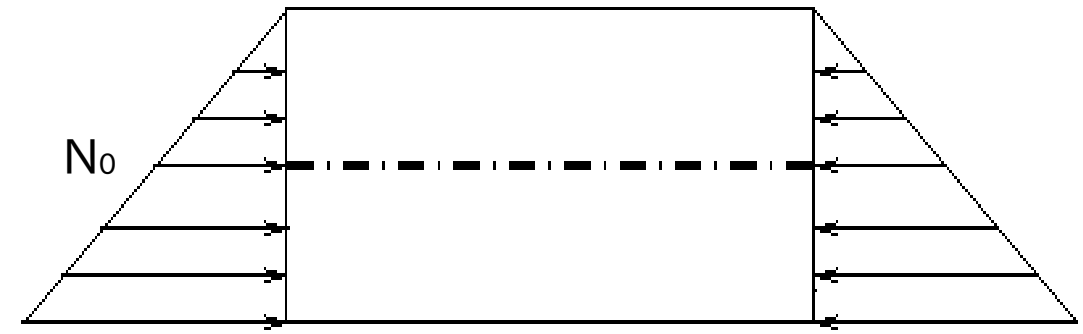
N0：軸力
α：偏心率



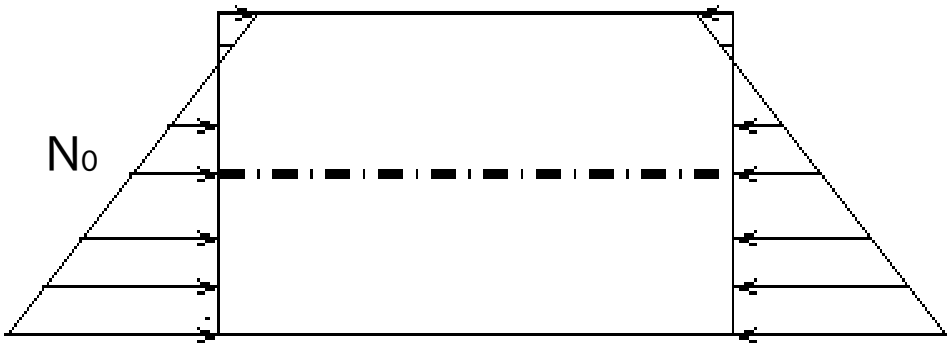
$\alpha = 0$



$0 < \alpha < 1$

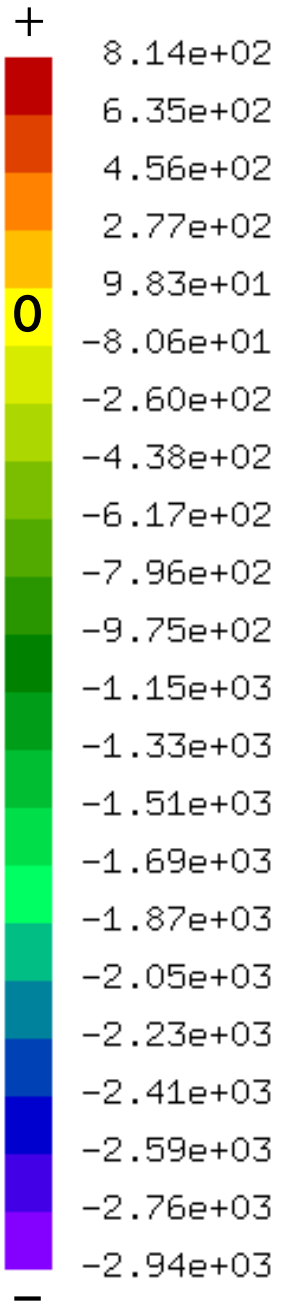


$\alpha = 1$

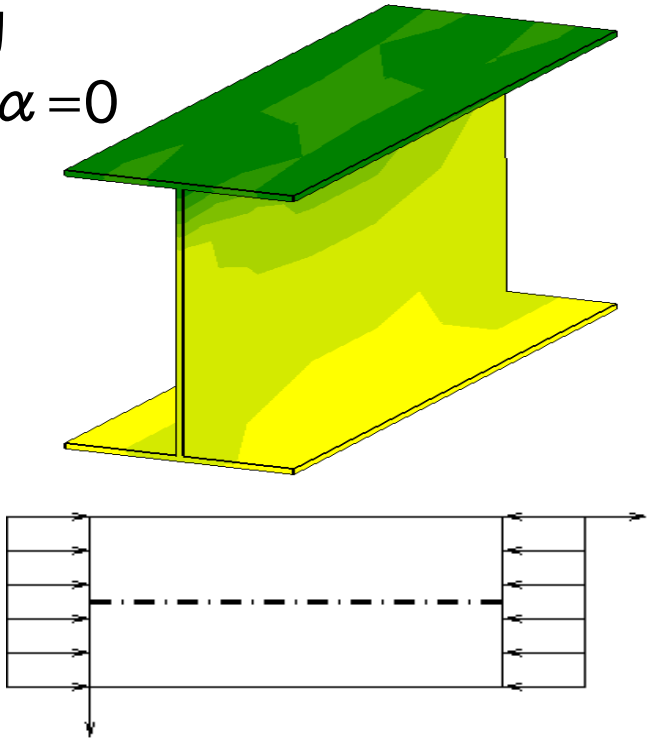


$\alpha > 1$

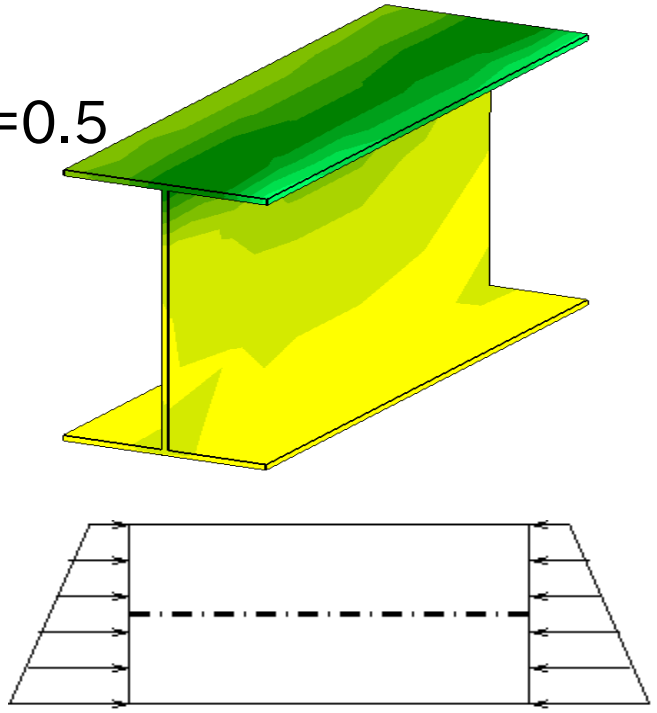
軸方向応力



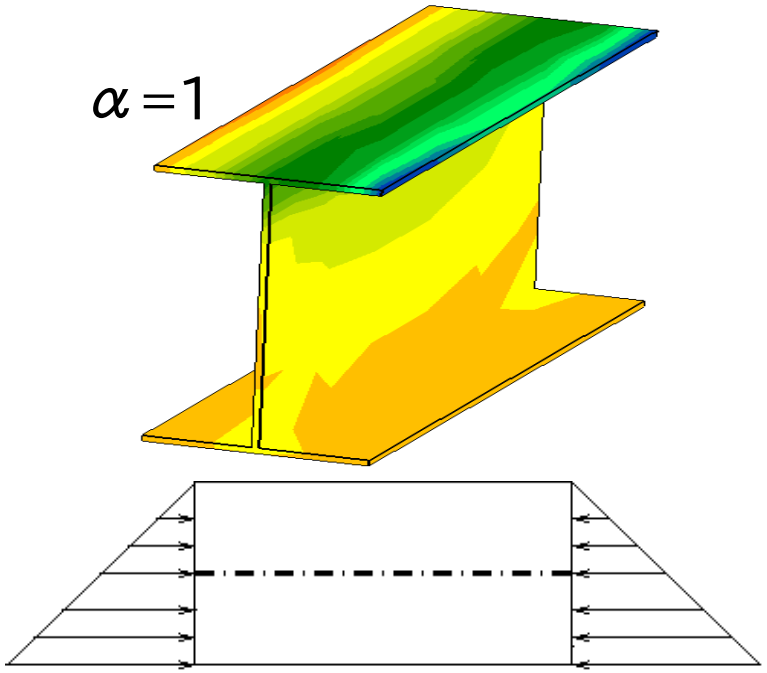
$\alpha = 0$



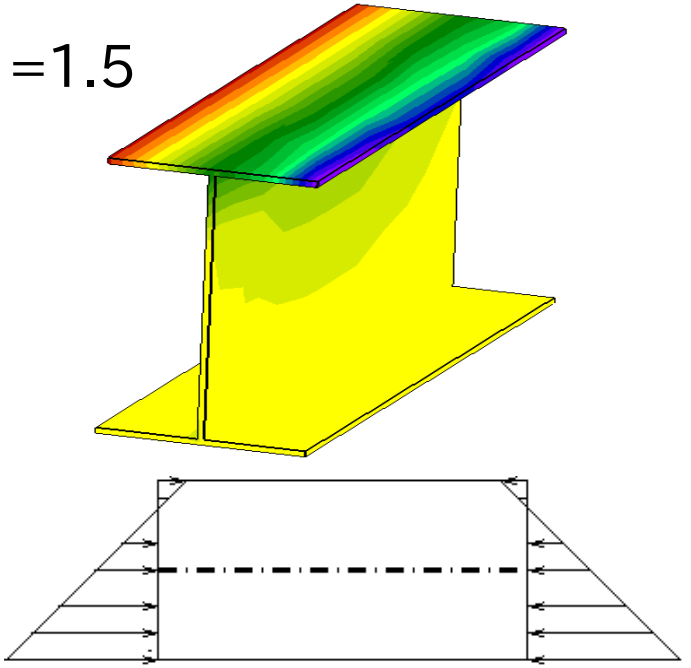
$\alpha = 0.5$



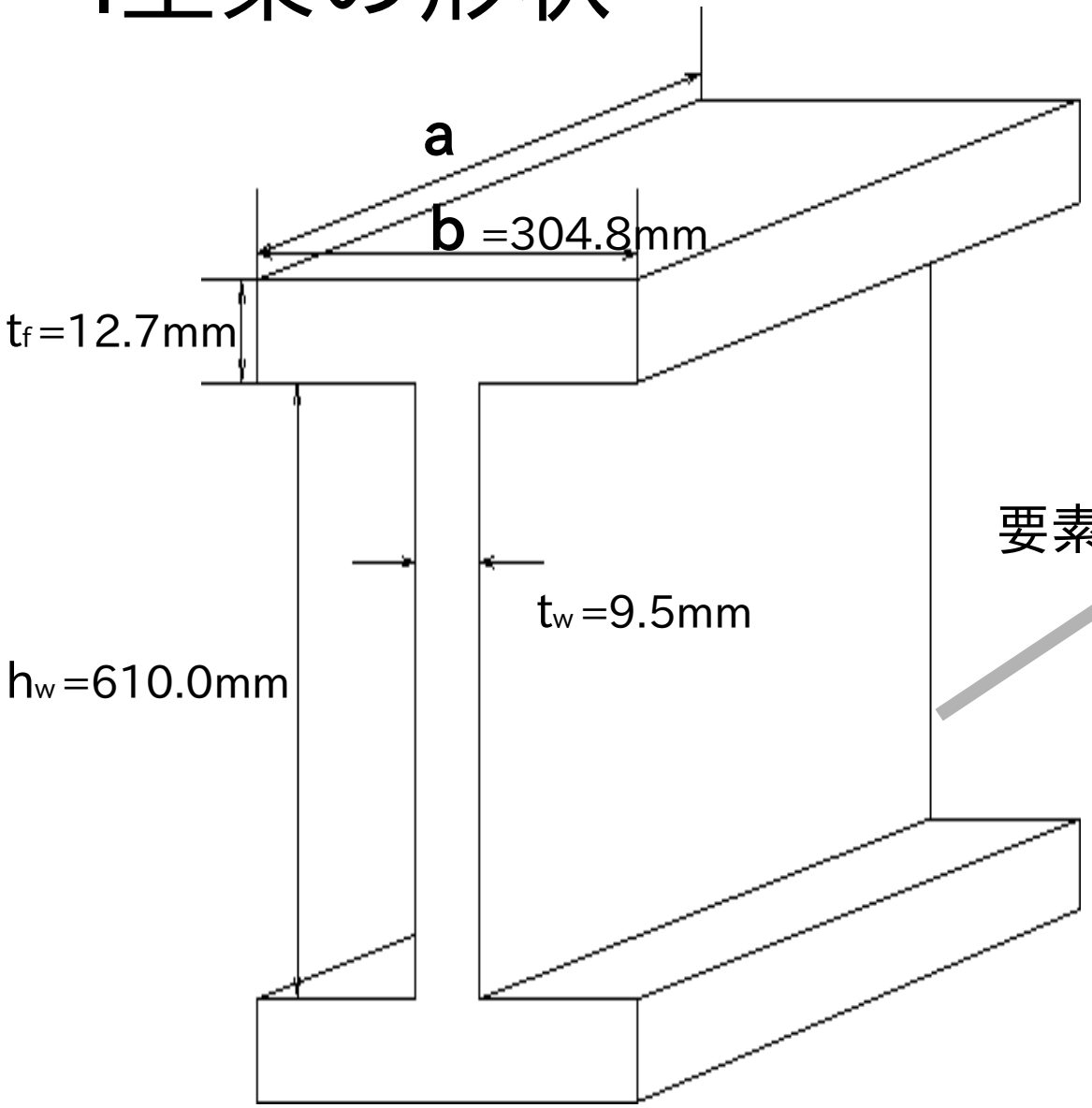
$\alpha = 1$

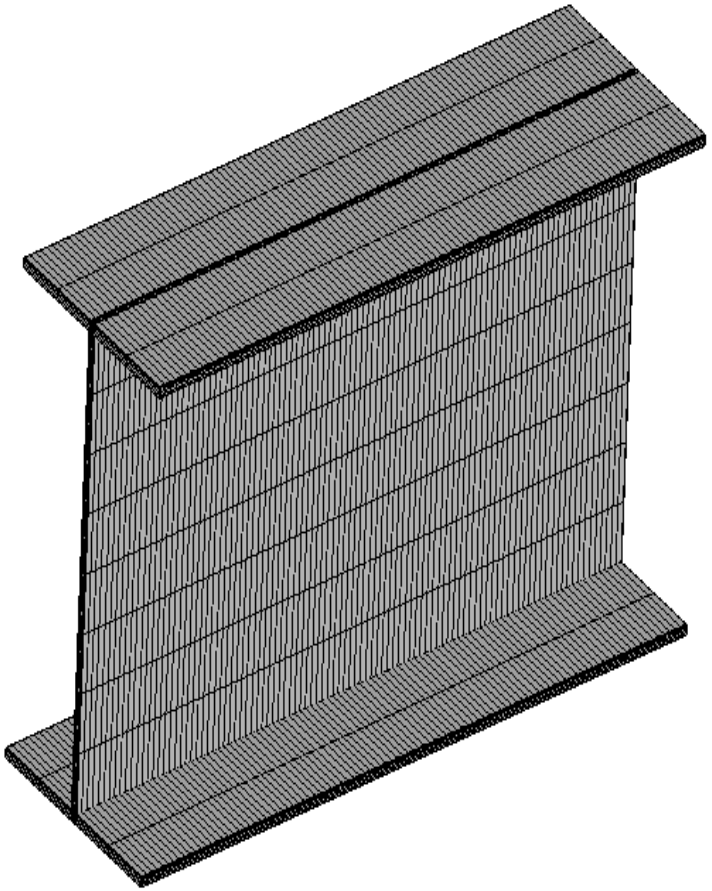


$\alpha = 1.5$



I型梁の形状





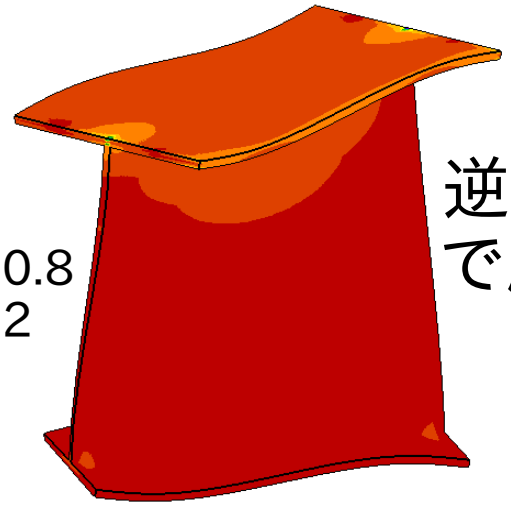
要素分割

アスペクト比：$\phi = \frac{a}{b}$

回転剛性：$\Gamma = \frac{4b}{h_w}\left(\frac{t_w}{t_f}\right)^3$

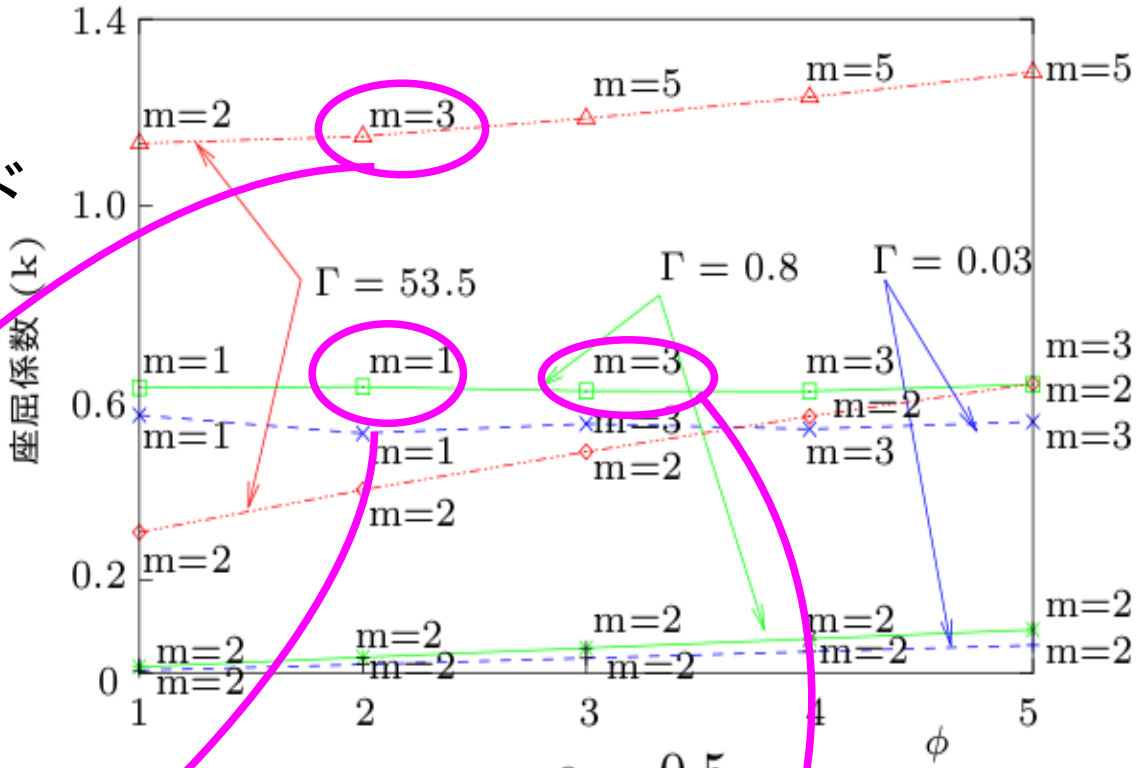
この梁の場合、
Γ =0.8 （ tw×4 のとき Γ =53.5
tw/3 のとき Γ =0.03 ）

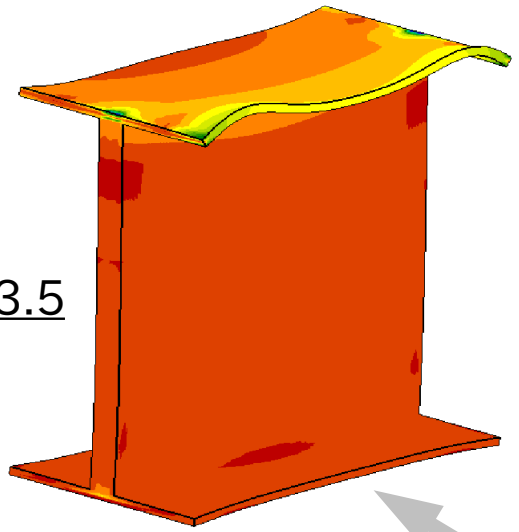
最小固有値においての座屈荷重



Γ = 0.8
φ = 2

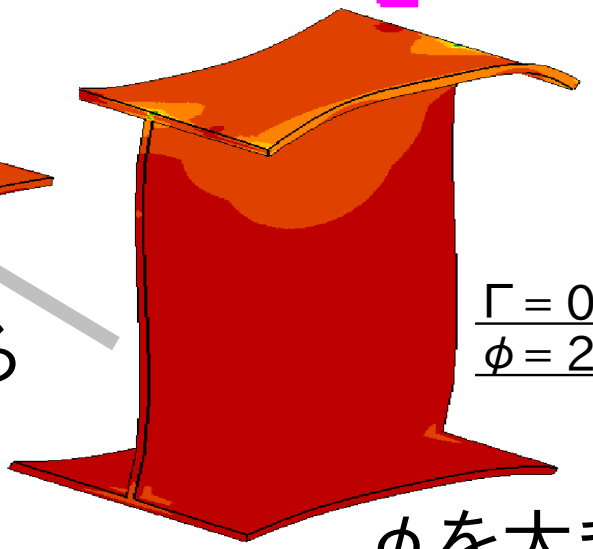
逆対称モードで座屈





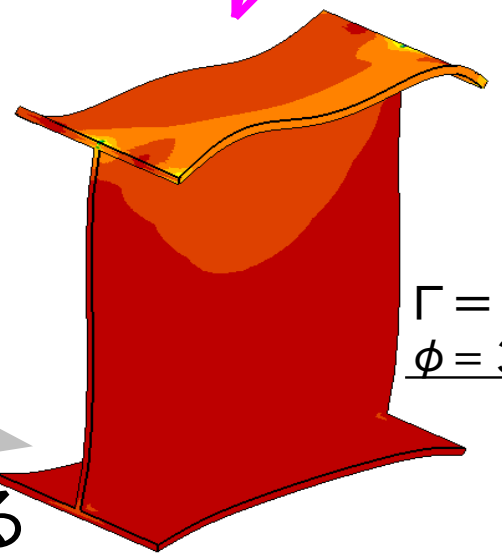
Γ = 53.5
φ = 2

Γ を大きくする



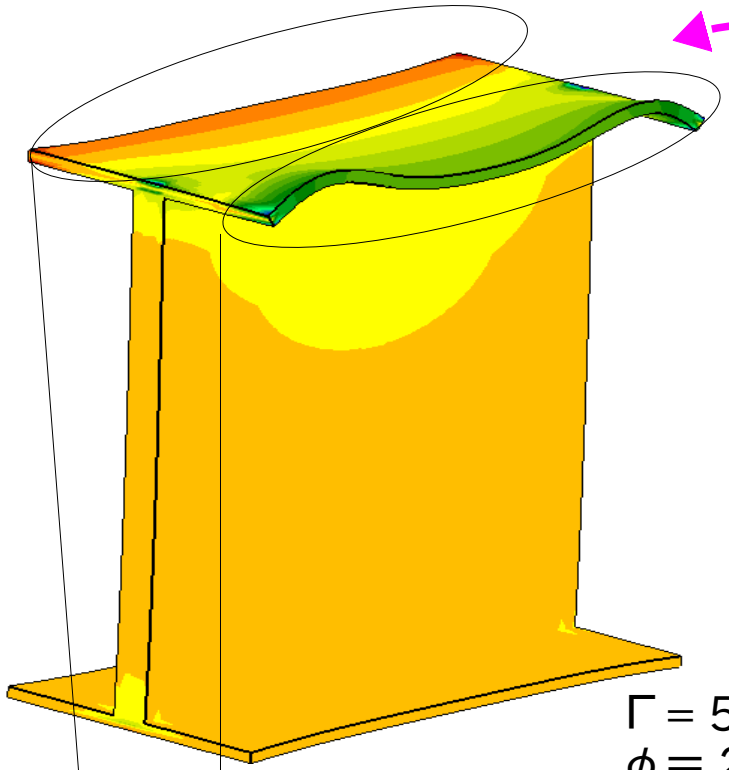
Γ = 0.8
φ = 2

φ を大きくする

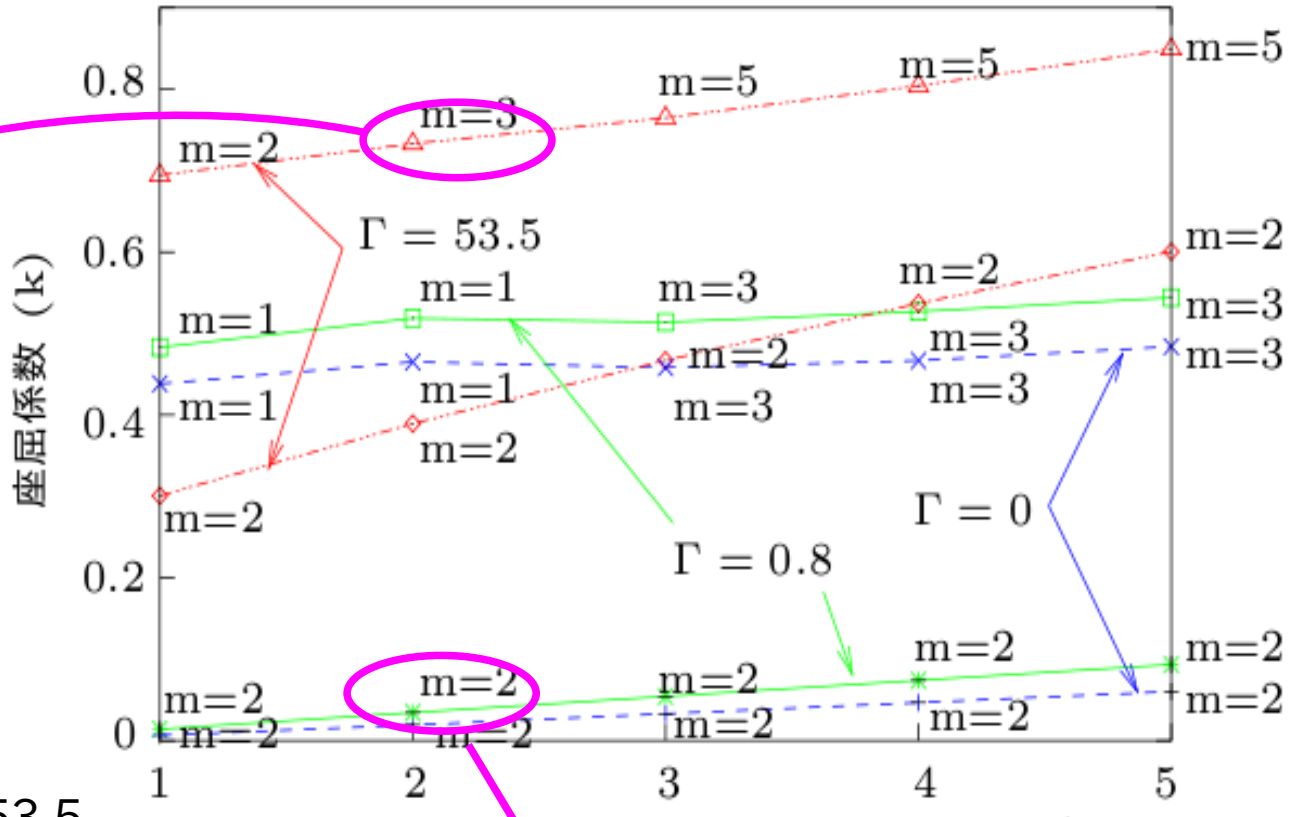


Γ = 0.8
φ = 3

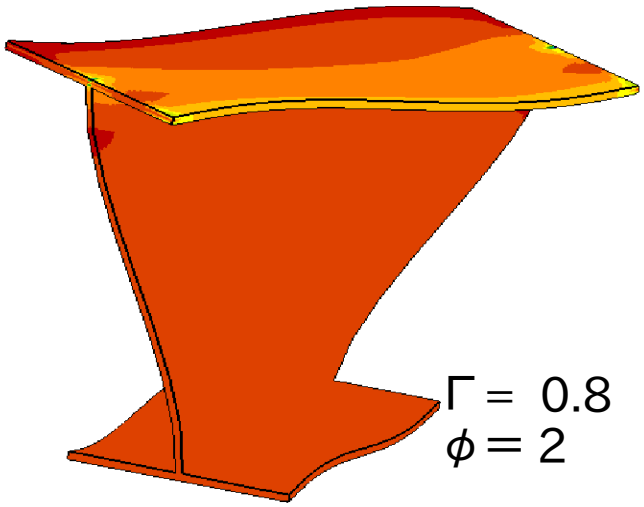
2番目に小さい座屈荷重



Γ = 53.5
φ = 2



$\alpha = 1.5$

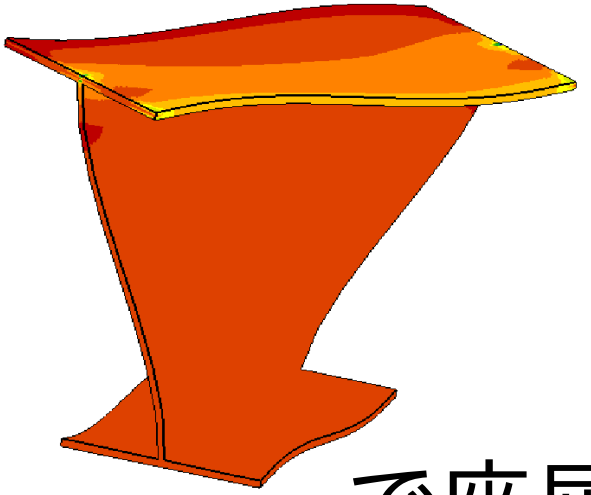


Γ = 0.8
φ = 2

圧縮側では座屈は起こるが

引張側では座屈が起きていない

まとめ

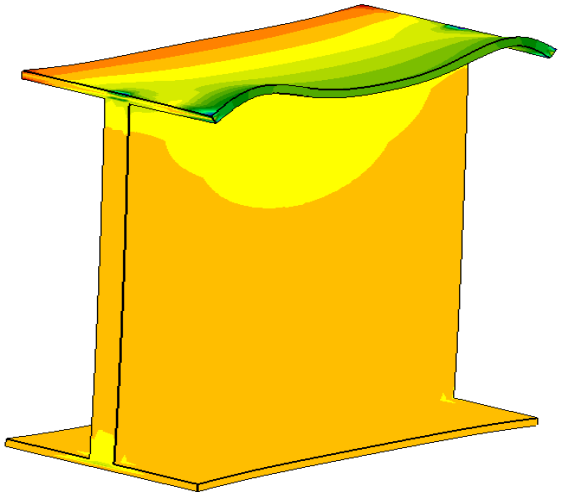


最小固有値に対応する座屈荷重

Γ, α, ϕ によらず { m=2 逆対称モード で座屈する

$\Gamma \rightarrow$大, $\alpha > 1$

圧縮側では座屈が起こるが
引張側では座屈は起こらない



目次

各節点に載荷される荷重

フランジ全断面に作用する合応力としての軸力

$$N = \frac{(\frac{2\alpha}{b}x+1-\alpha)N_0}{n_{fy}+1}$$

フランジ幅方向の要素分割

座屈係数：k

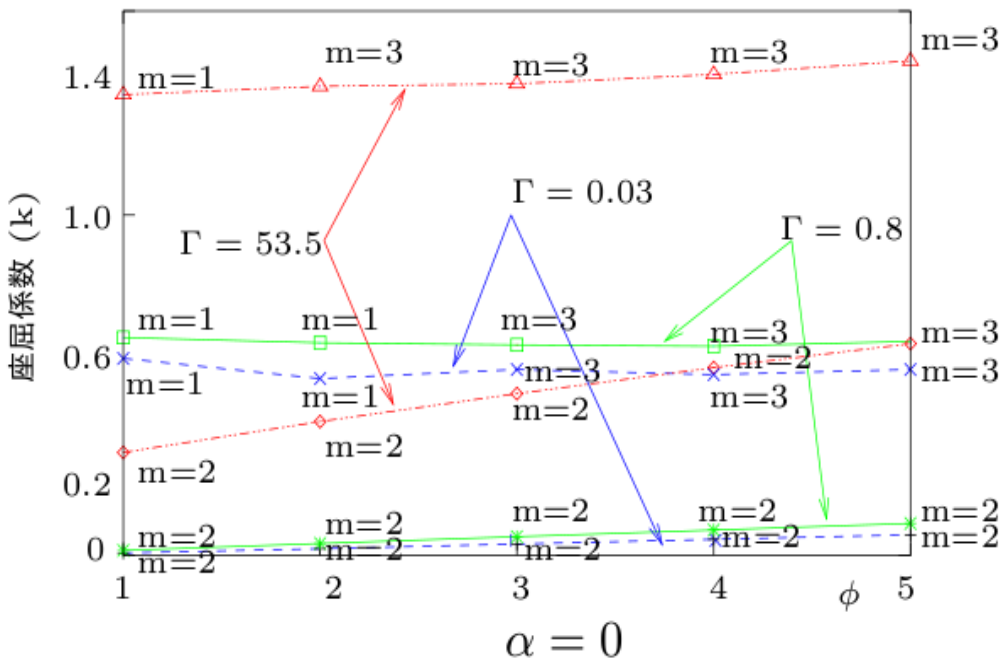
ヤング率

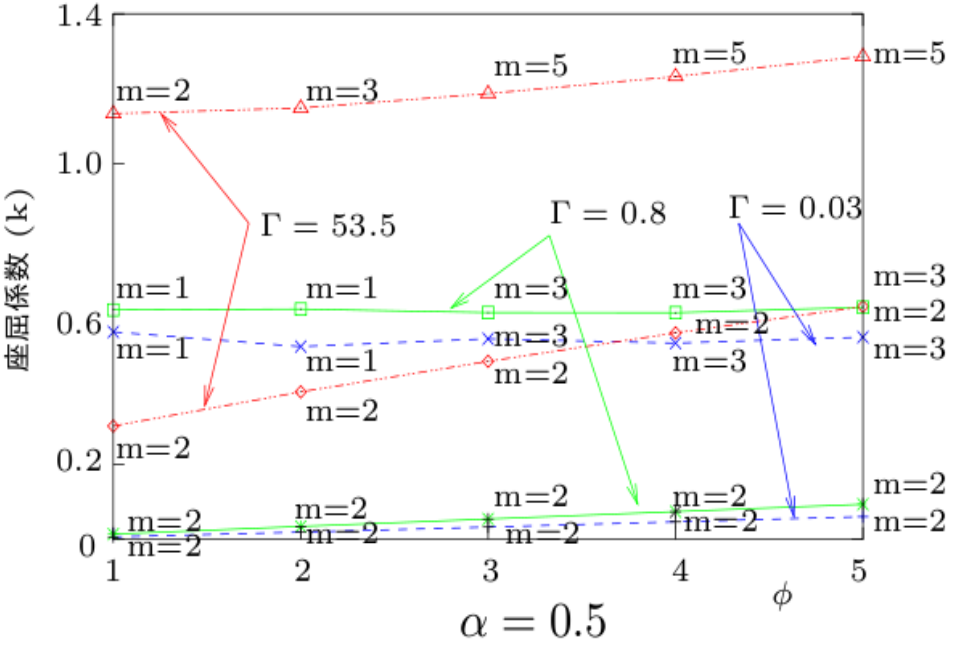
$$\sigma = \frac{\pi^2 E}{12(1-\nu^2)}(\frac{t_f}{b})^2$$

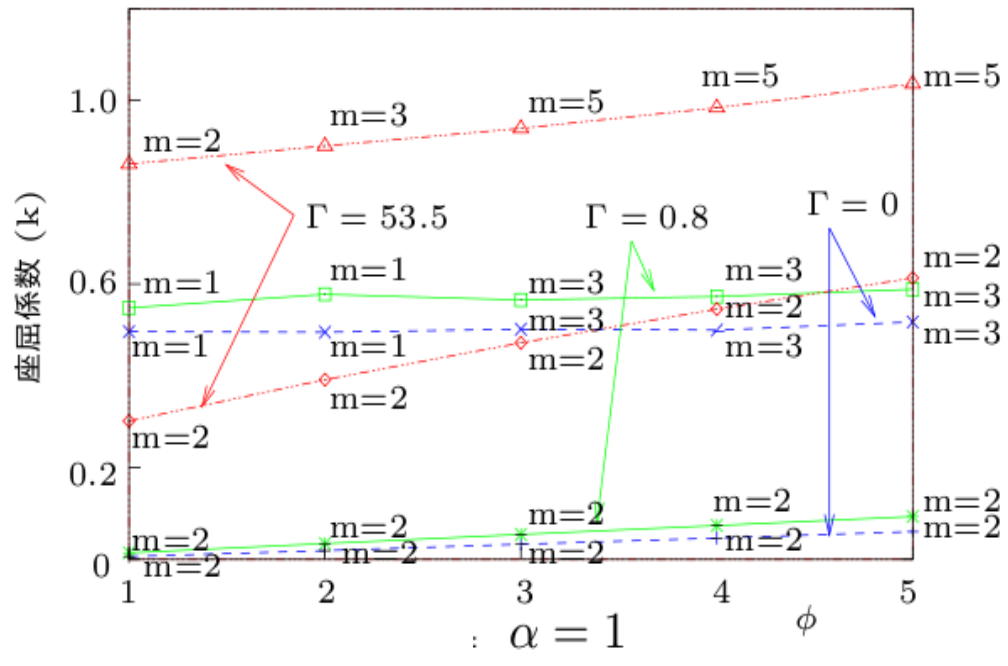
ポアソン比

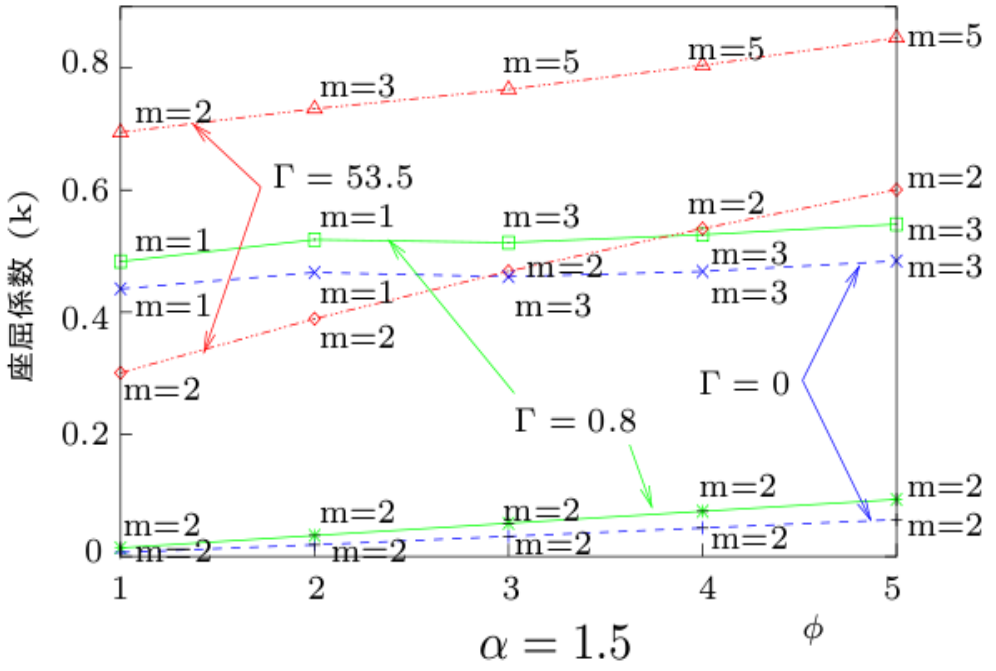
$$k = \frac{P_{cr}}{\sigma b t_f}$$

座屈荷重


座屈係数（k）
1.4
1.0
0.6
0.2
0
1
2
3
4
5
ϕ
$\Gamma = 53.5$
$\Gamma = 0.03$
$\Gamma = 0.8$
m=1
m=2
m=3
$\alpha = 0$


座屈係数（k）
1.4
1.0
0.6
0.2
0
1
2
3
4
5
ϕ
$\Gamma = 53.5$
$\Gamma = 0.8$
$\Gamma = 0.03$
m=1
m=2
m=3
m=5
$\alpha = 0.5$


座屈係数（k）
1.0
0.6
0.2
0
1
2
3
4
5
ϕ
$\Gamma = 53.5$
$\Gamma = 0.8$
$\Gamma = 0$
m=1
m=2
m=3
m=5
$\alpha = 1$


座屈係数（k）
0.8
0.6
0.4
0.2
0
1
2
3
4
5
ϕ
$\Gamma = 53.5$
$\Gamma = 0.8$
$\Gamma = 0$
m=1
m=2
m=3
m=5
$\alpha = 1.5$