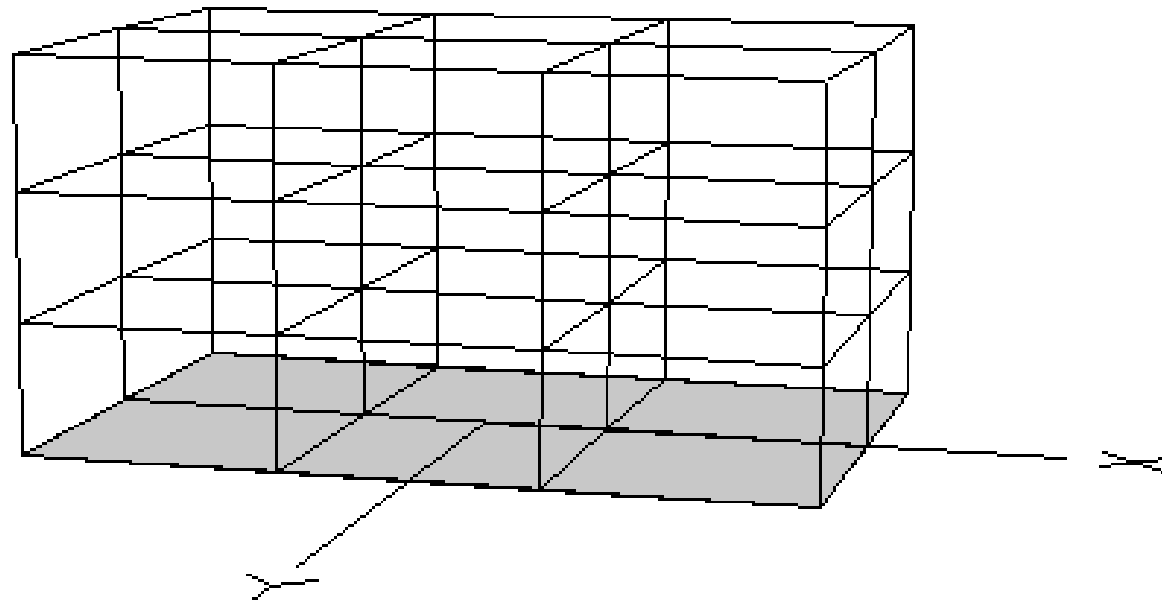


基本仮定

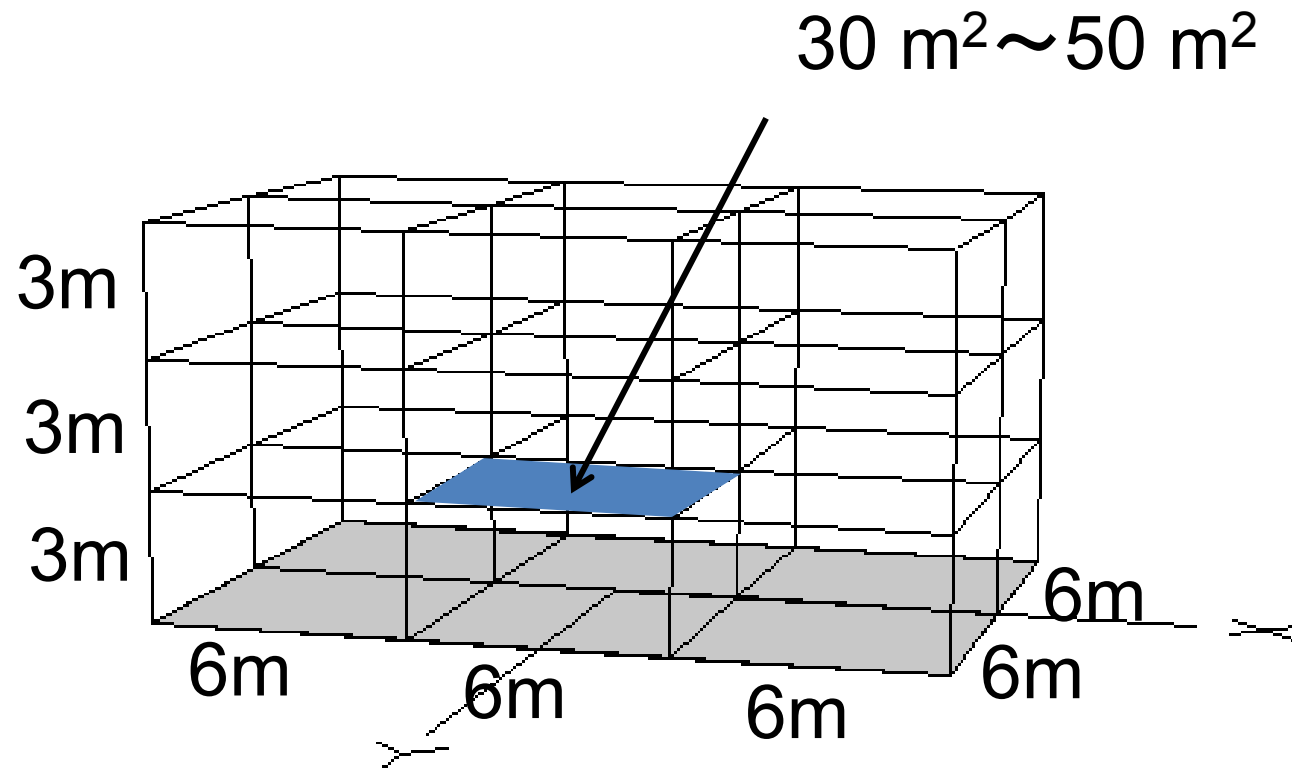
鉄筋コンクリート造骨組

3階建

2×3スパン

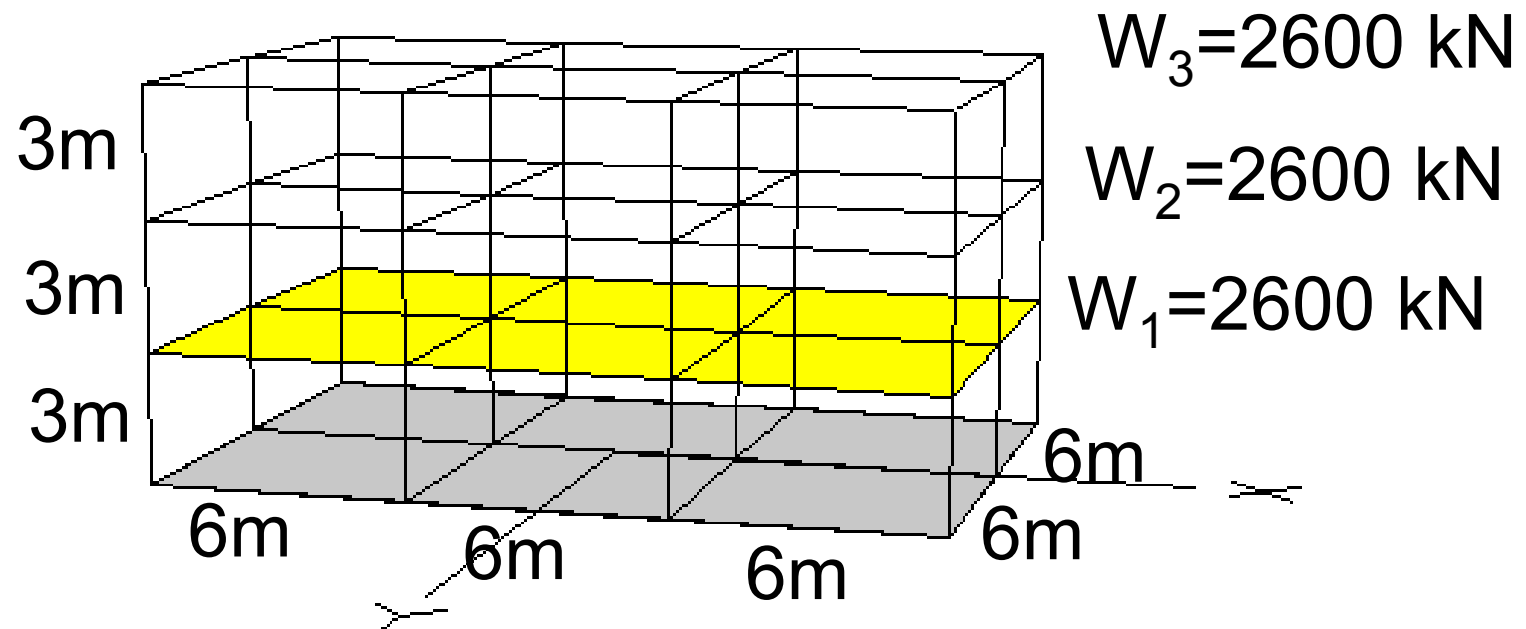


スパン



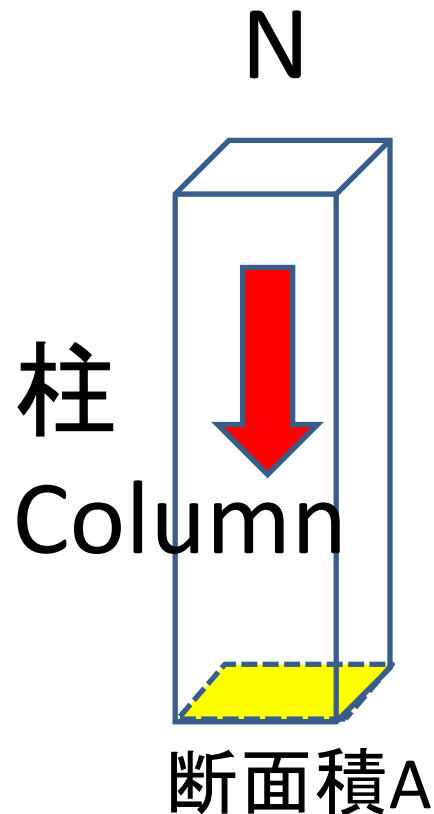
建物重量

12 kN / m²



コンクリート強度

$$F_c = 240 \text{ (kg/cm}^2\text{)} \\ = 24 \text{ (MPa, N/mm}^2\text{)}$$



軸力(長期許容応力度)

$$N = 0.2 F_c \times A$$

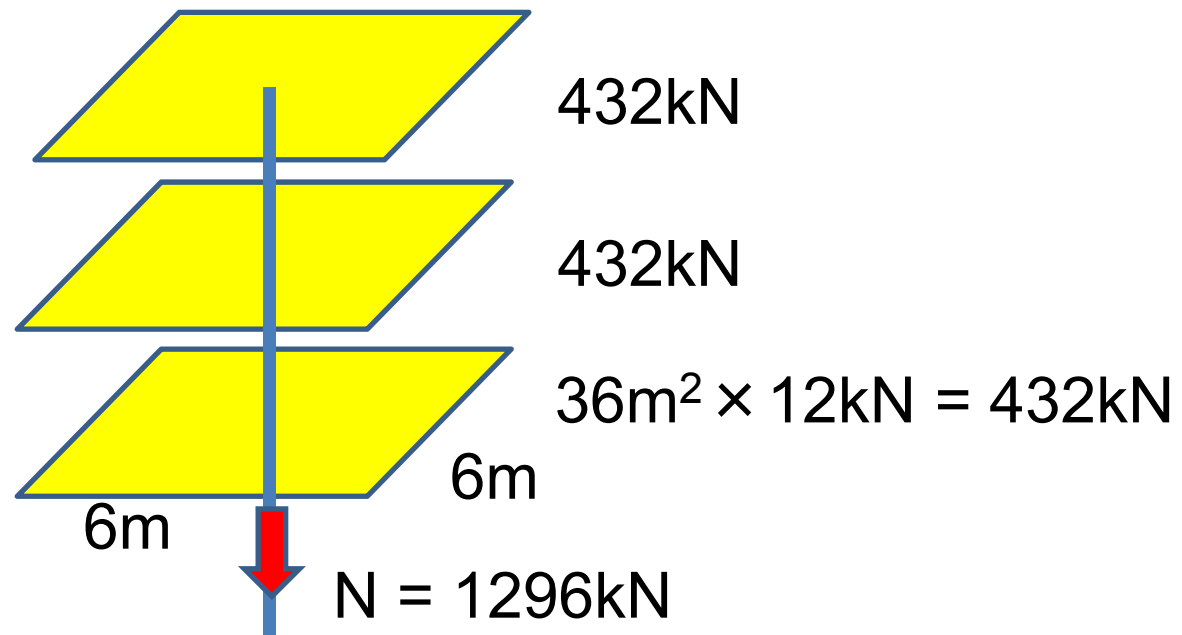
$$< (1/3) F_c \times A$$

柱サイズ

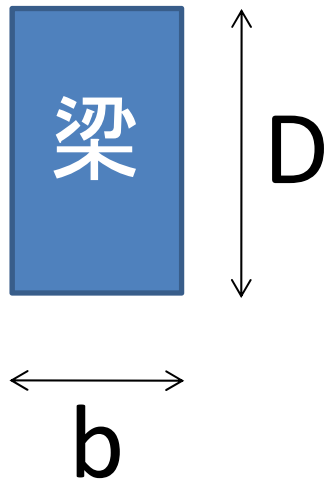
柱

$$A = N / (0.2F_c) = 1296(\text{kN}) / 4.8(\text{N}/\text{mm}^2) = 2700 (\text{cm}^2)$$

$$\rightarrow 60\text{cm} \times 60\text{cm}$$



梁サイズ



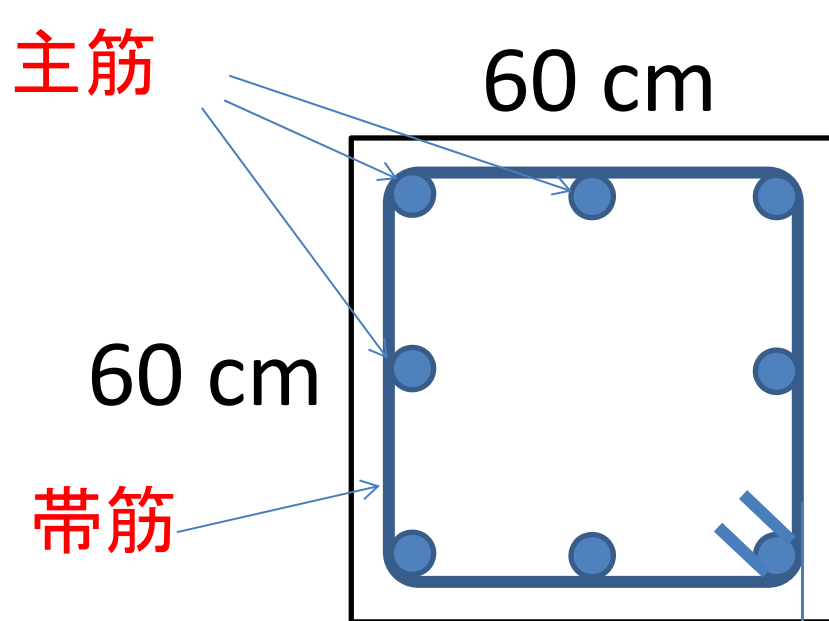
梁成 $D \approx (\text{スパン}) \times 1/10$

$$D = 60 \text{ cm}$$

梁幅 $b \approx D \times 1/2$

$$b = 30 \text{ cm}$$

柱配筋



D10 or D13
 間隔 10 cm (端部)
 15 cm (中央)
 → 2-D13@100

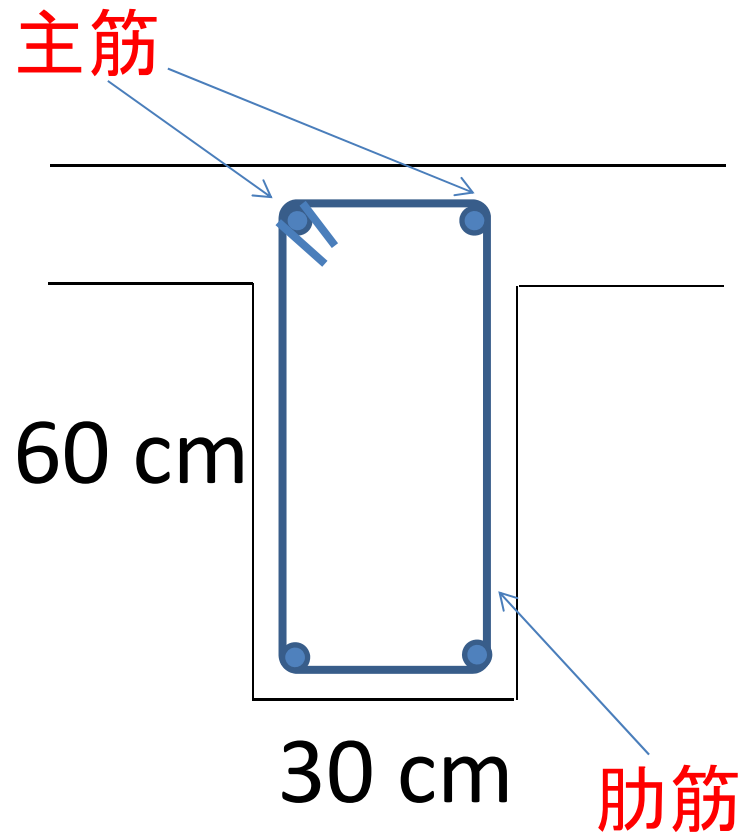
$$\text{最小鉄筋量} = \frac{\text{全主筋断面積}}{\text{柱断面積}}$$

> 0.8 %

主筋全鉄筋断面積
 $= 3600\text{cm}^2 \times 0.008 = 28.8\text{ cm}^2$
 → D22 (3.87cm^2) × 8本

被り厚 > 40mm

梁配筋

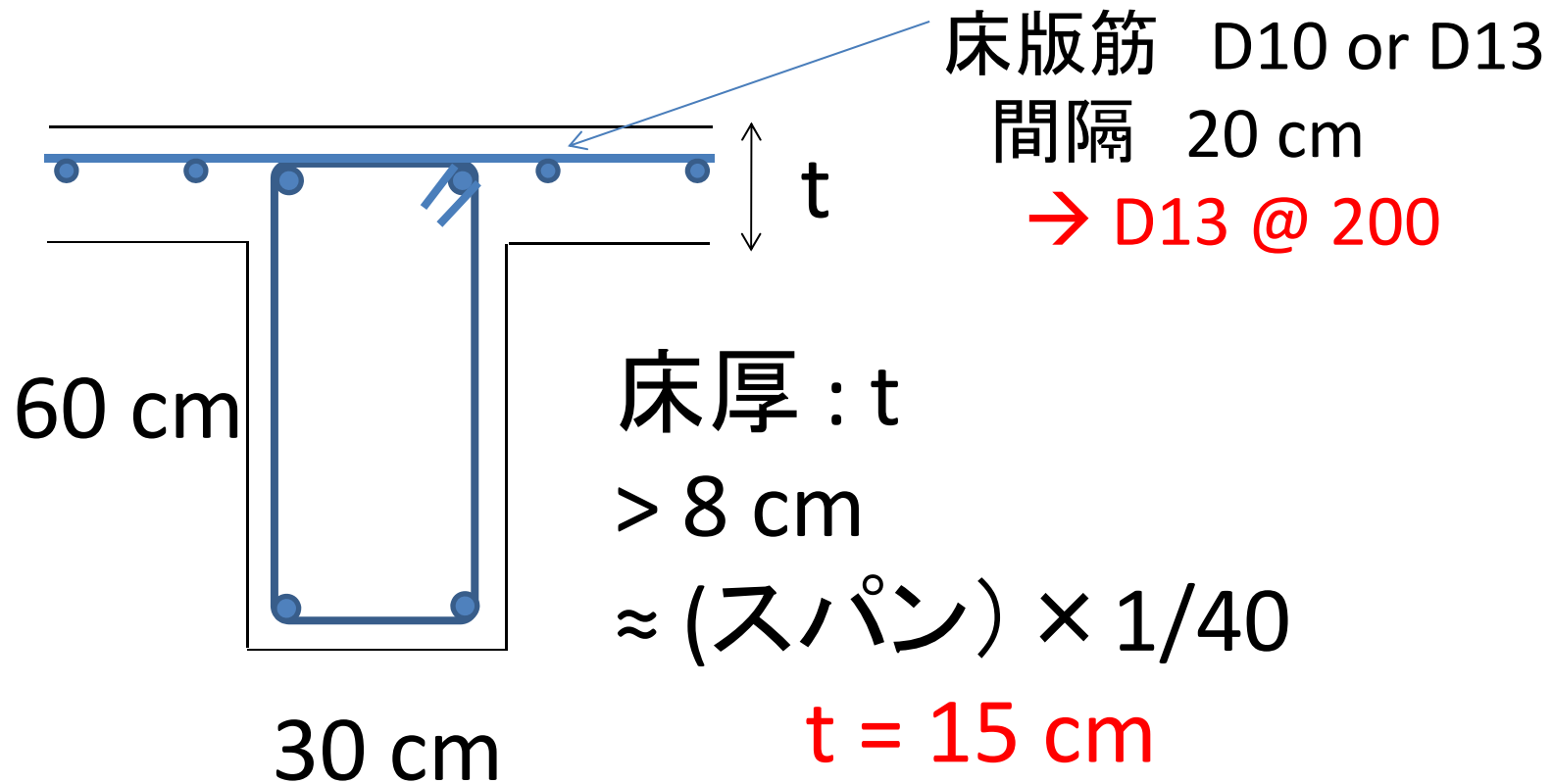


$$\text{最小引張鉄筋量} = \frac{\text{引張側主筋断面積}}{\text{梁断面積}} > 0.4 \%$$

$$\begin{aligned} \text{引張側主筋断面積} \\ &= 1800\text{cm}^2 \times 0.004 = 7.2 \text{ cm}^2 \\ &\rightarrow \text{D22 (3.87cm}^2) \times 2\text{本} \end{aligned}$$

D10 or D13
 間隔 15 cm (端部)
 20 cm (中央)
 $\rightarrow 2\text{-D13@150}$

スラブ配筋



鉄筋強度

規格

引張強度

SD295

3.0 (t/cm²) = 295 (MPa, N/mm²)

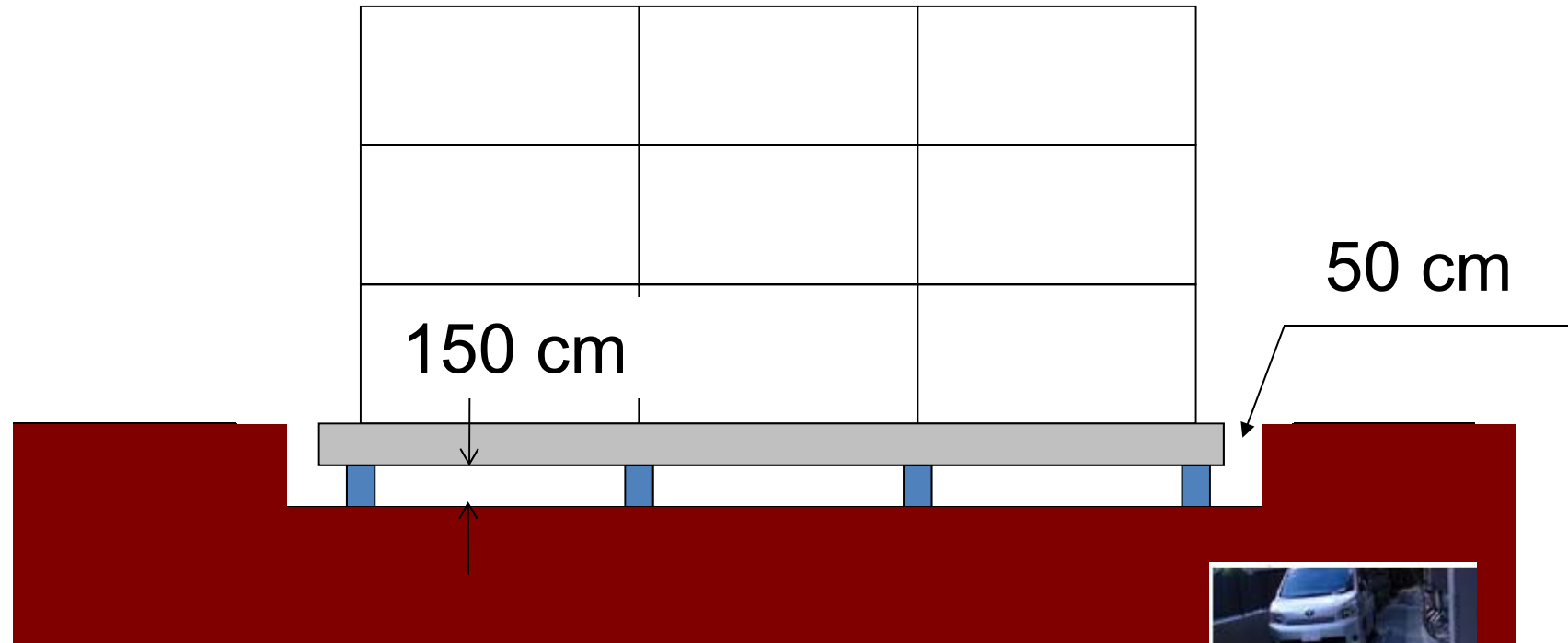
SD345

3.5 (t/cm²) = 345 (MPa, N/mm²)

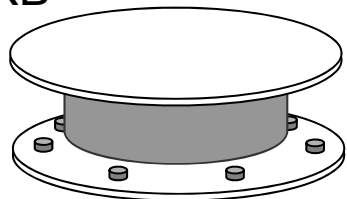
SD390

4.0 (t/cm²) = 395 (MPa, N/mm²)

免震層の設計

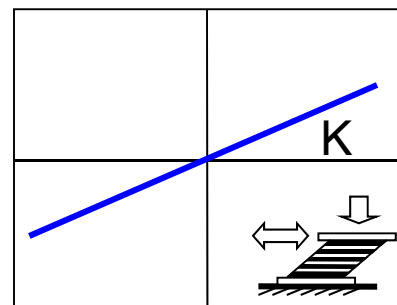


Natural Rubber Bearing
NRB



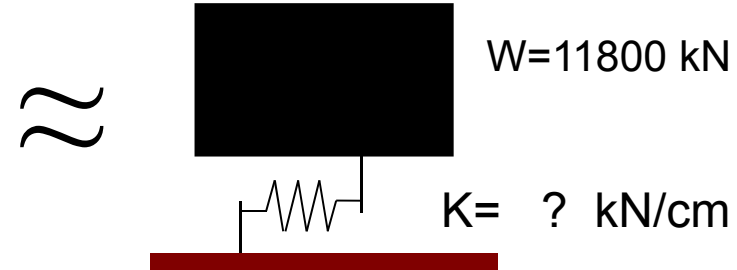
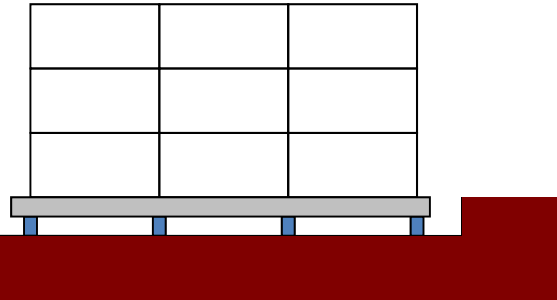
天然ゴム系積層ゴム

水平力



免震周期の設定

$$\begin{aligned} W_3 &= 2600 \text{ kN} \\ W_2 &= 2600 \text{ kN} \\ W_1 &= 2600 \text{ kN} \\ W_B &= 4000 \text{ kN} \end{aligned}$$



周期

$$T = 2\pi \sqrt{\frac{m}{K}} = 2\pi \sqrt{\frac{W/g}{K}}$$

質量 重量

重力加速度
 $g = 980 \text{ cm/sec}^2$

目標周期 $T = 4 \text{ sec}$

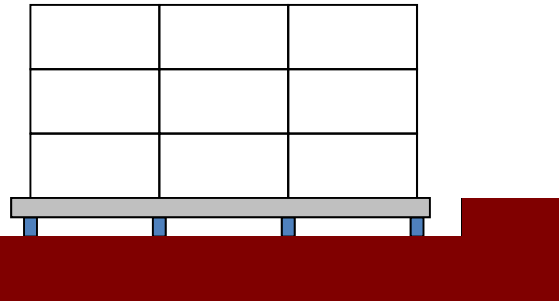
免震層の剛性

$$K = \left(\frac{2\pi}{T} \right)^2 \frac{W}{g}$$

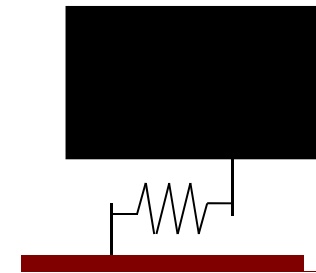
$$K = \left(\frac{2\pi}{4} \right)^2 \frac{11800}{980} = 30 \text{ kN/cm}$$

積層ゴムの剛性

$W_3=2600 \text{ kN}$
 $W_2=2600 \text{ kN}$
 $W_1=2600 \text{ kN}$
 $W_B=4000 \text{ kN}$

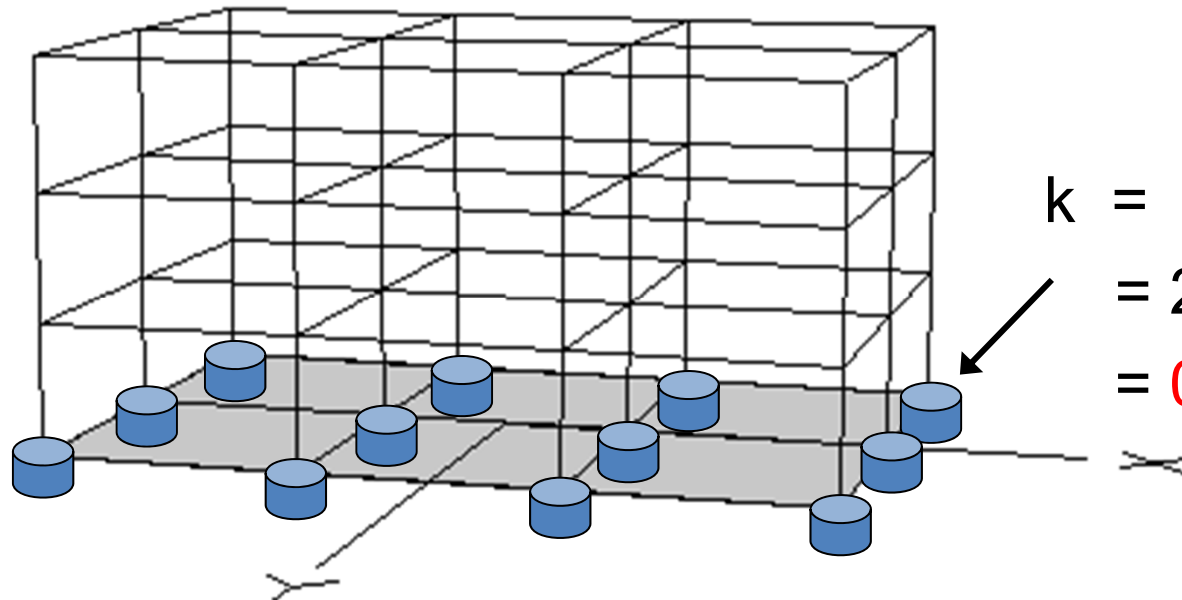


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$W=11800 \text{ kN}$

$K=30 \text{ kN/cm}$

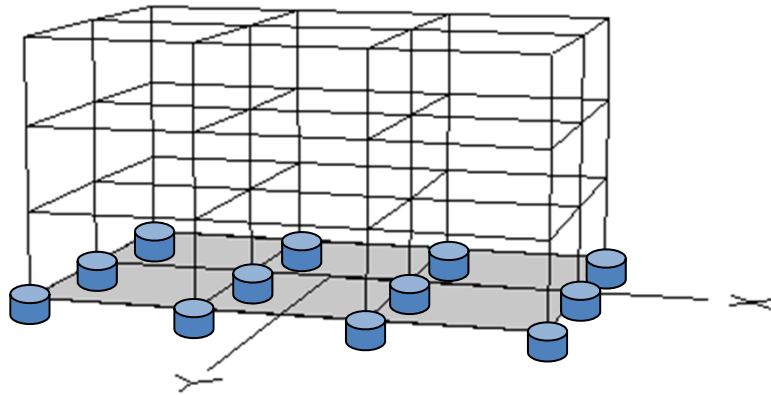


$$k = K / 12 \text{ 個}$$

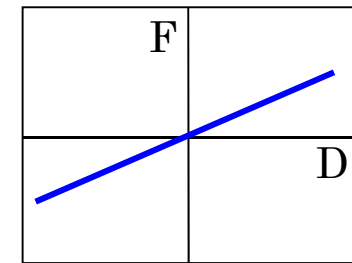
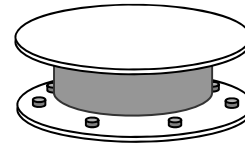
$$= 2.5 \text{ kN/cm}$$

$$= 0.25 \text{ kN/mm}$$

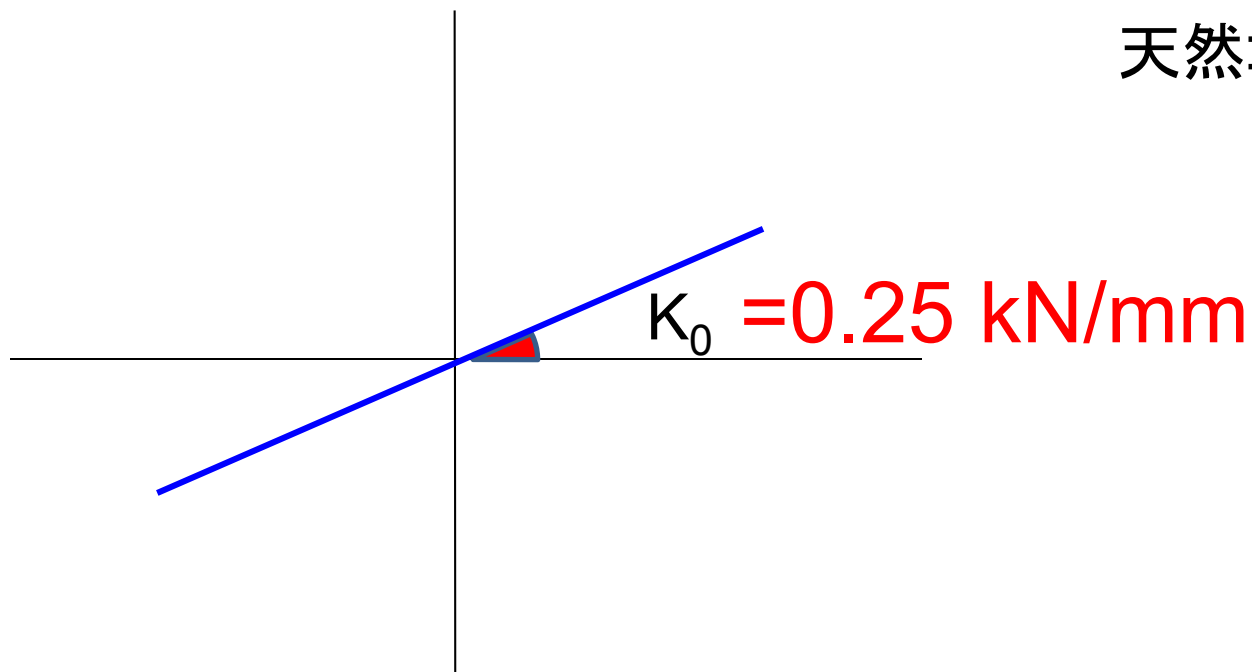
積層ゴムの剛性



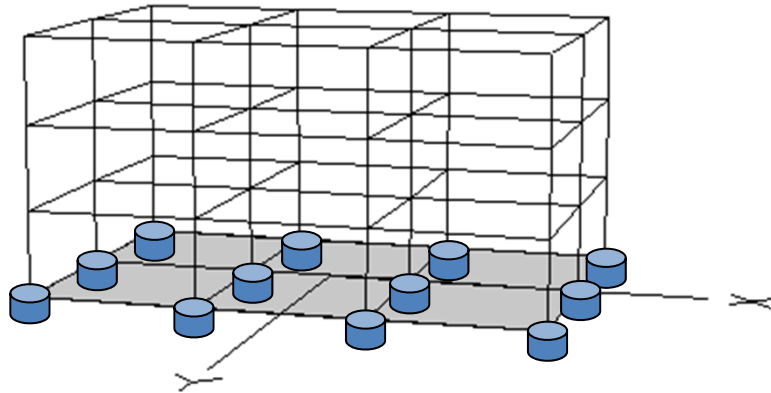
Natural Rubber Bearing (NRB)



天然ゴム系積層ゴム

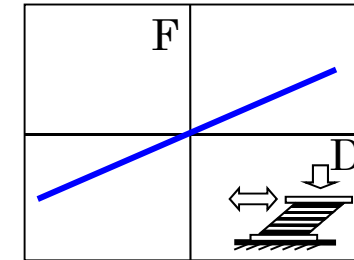
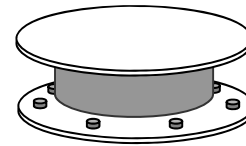


減衰装置(ダンパー)の設計



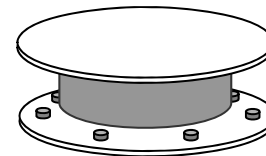
天然ゴム系積層ゴム

Natural Rubber Bearing (NRB)



Lead Rubber Bearing (LRB)

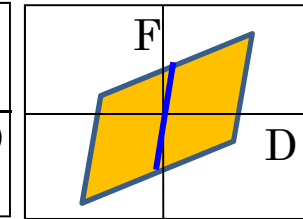
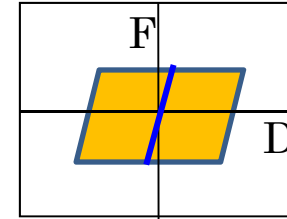
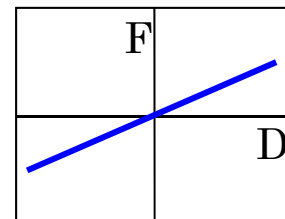
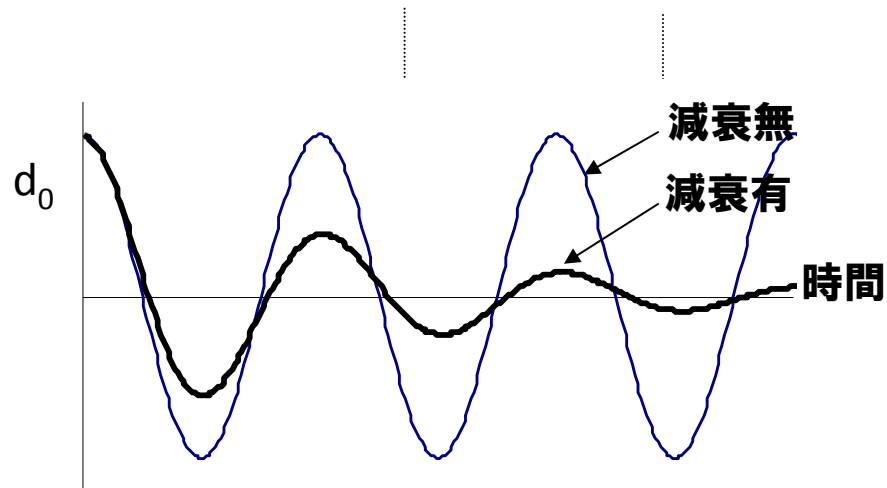
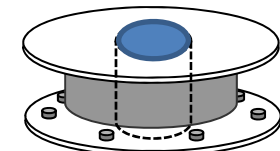
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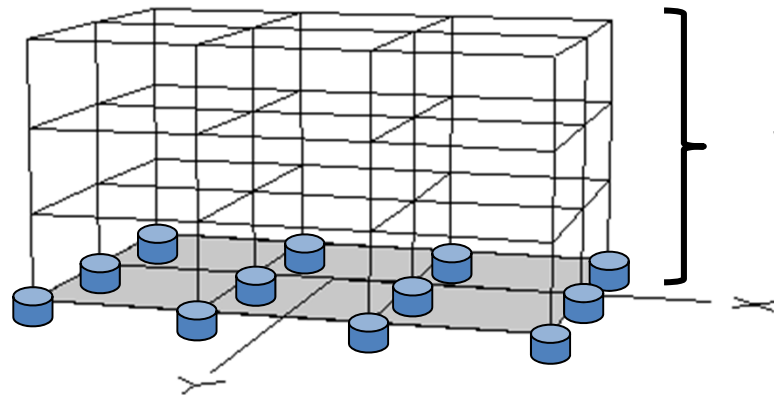


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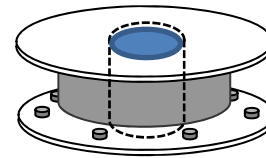


鉛入り積層ゴム

鉛入り積層ゴムの設計



$W=11800 \text{ kN}$



$$F_y \approx 100 \text{ kN}$$

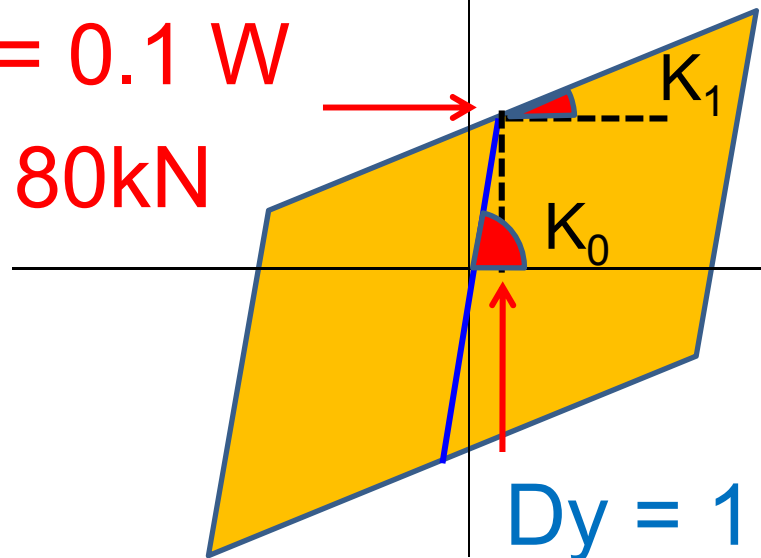
$$K_0 \approx 10 \text{ kN/mm}$$

$$K_1 / K_0 \approx 0.025$$

1/12

$$F_y = 0.1 W$$

$$= 1180 \text{ kN}$$



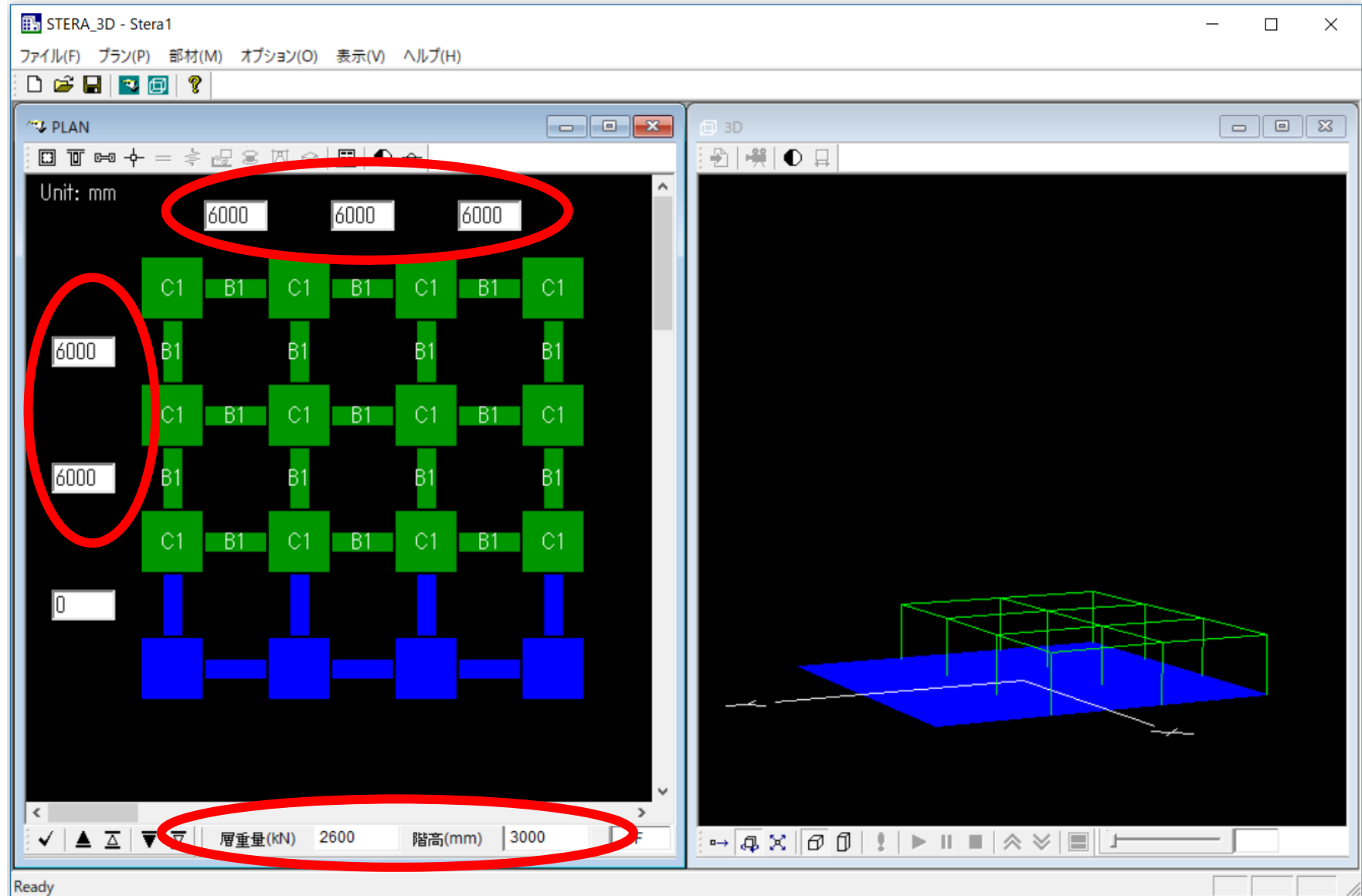
$$K_1 = 30 \text{ kN/cm}$$

$$K_0 = 1180 \text{ kN/cm}$$

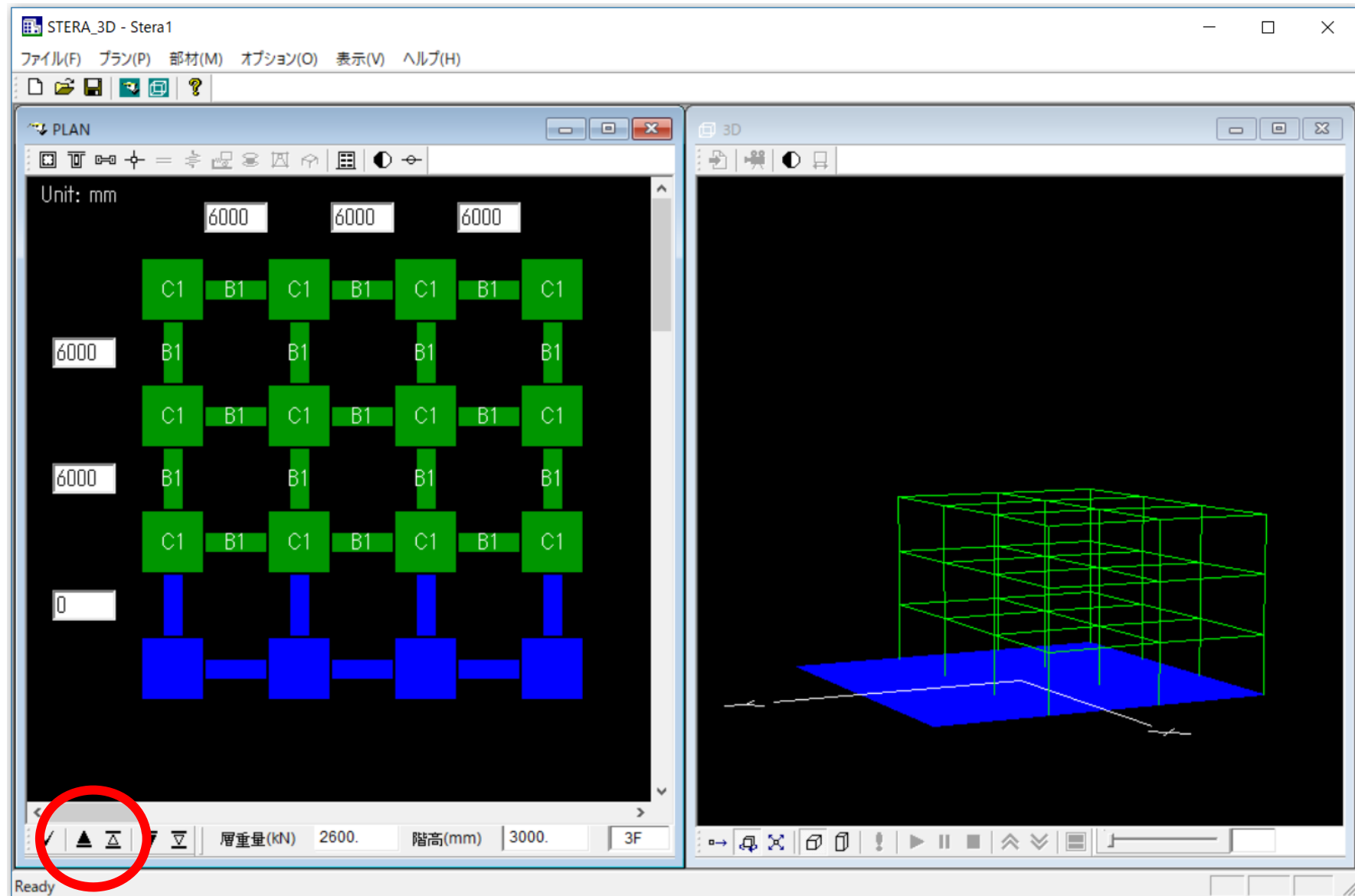
$$K_1 / K_0 \approx 0.025$$

$$D_y = 1 \text{ cm}$$

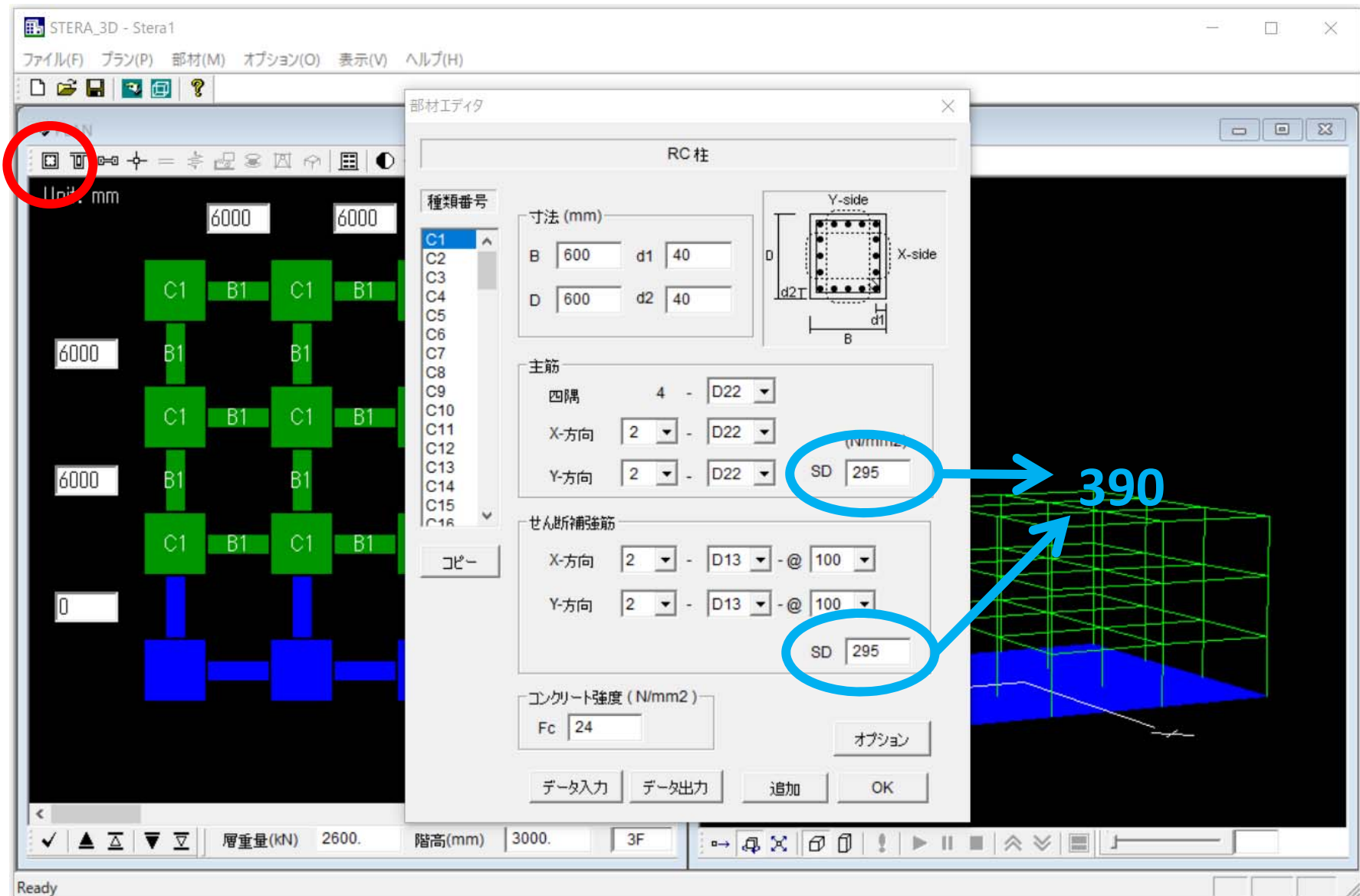
STERA 3D (建物寸法入力)



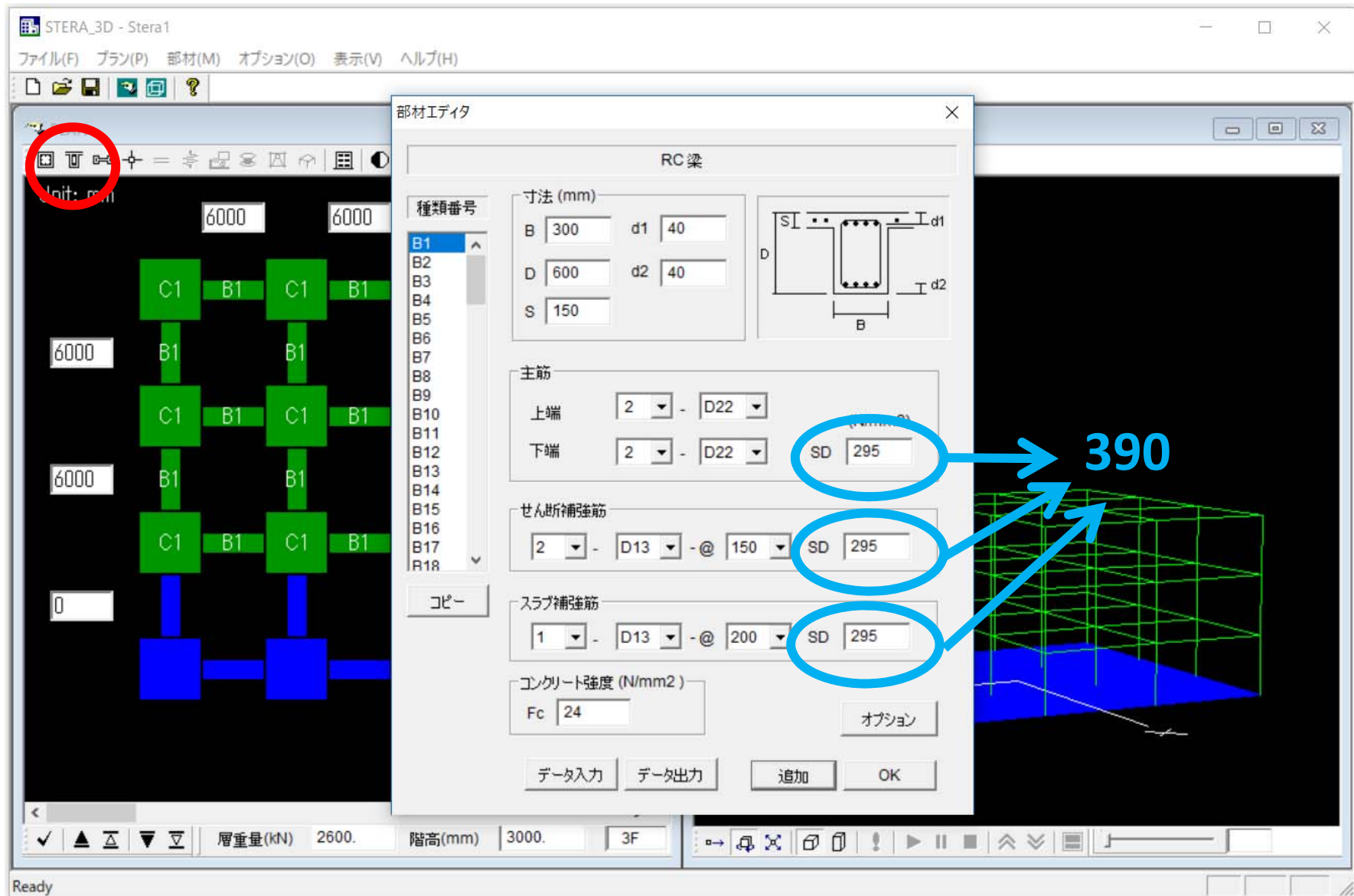
STERA 3D (上の階に移動・コピー)



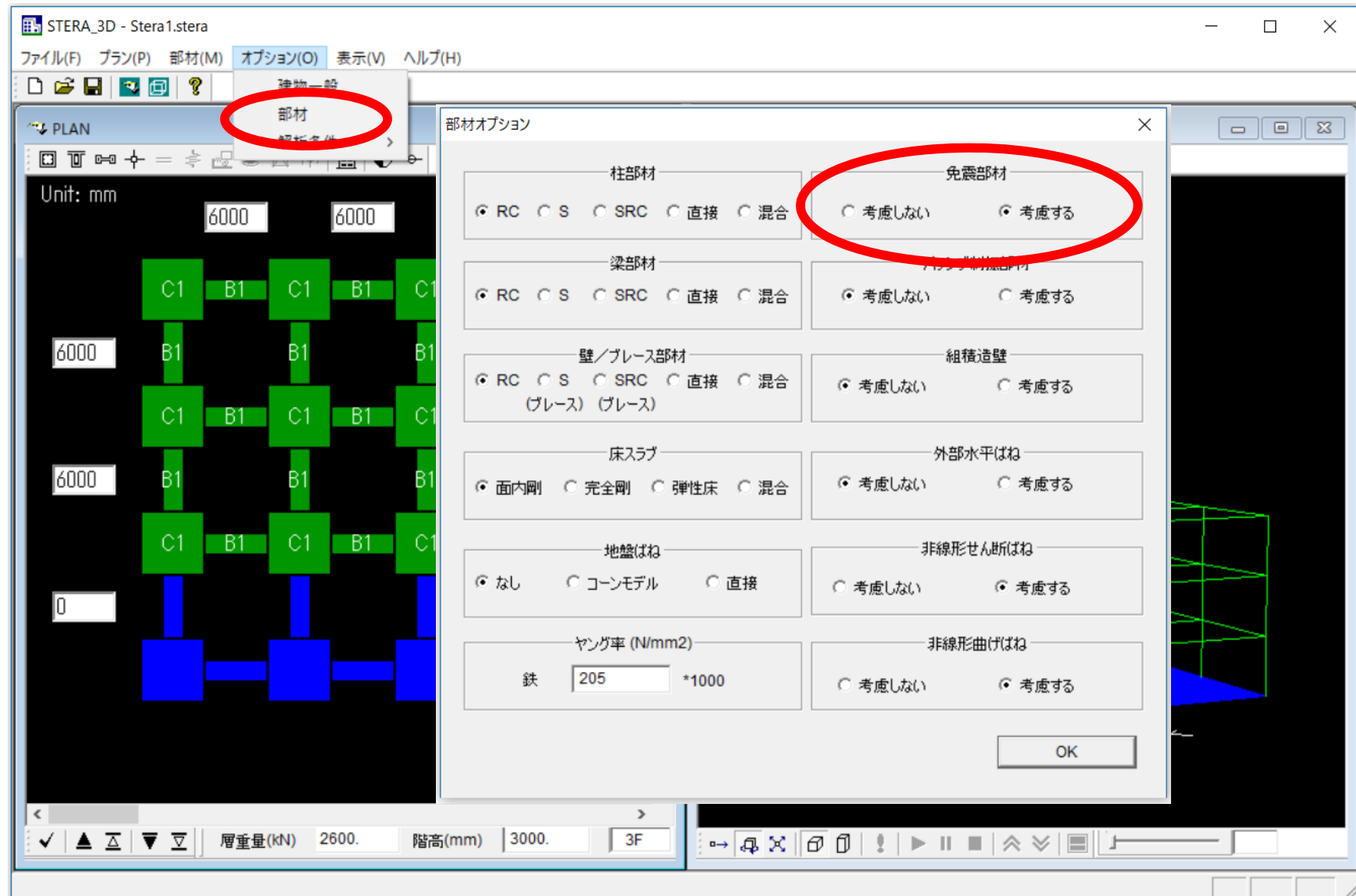
STERA 3D (柱断面入力)



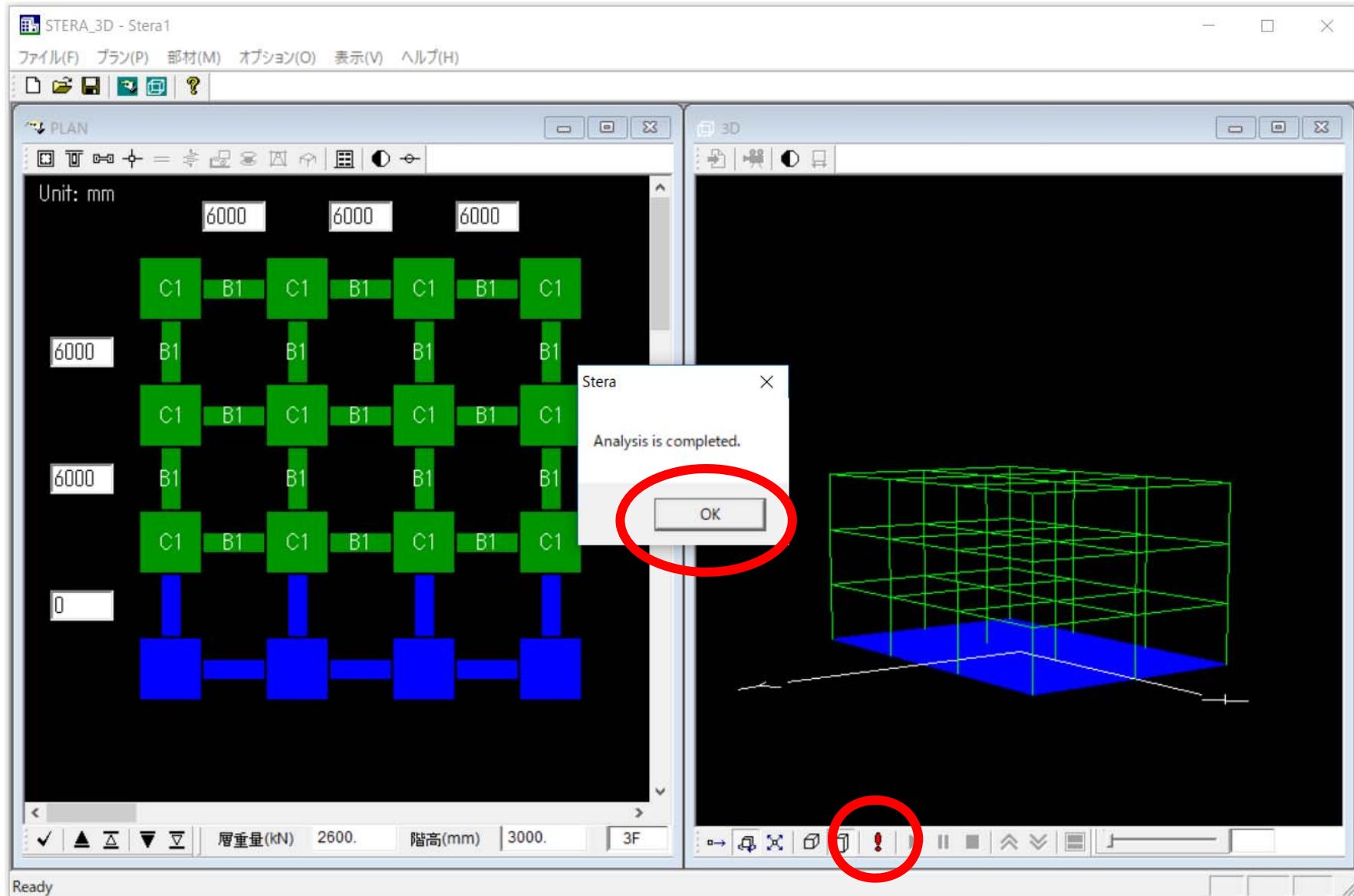
STERA 3D (梁断面入力)



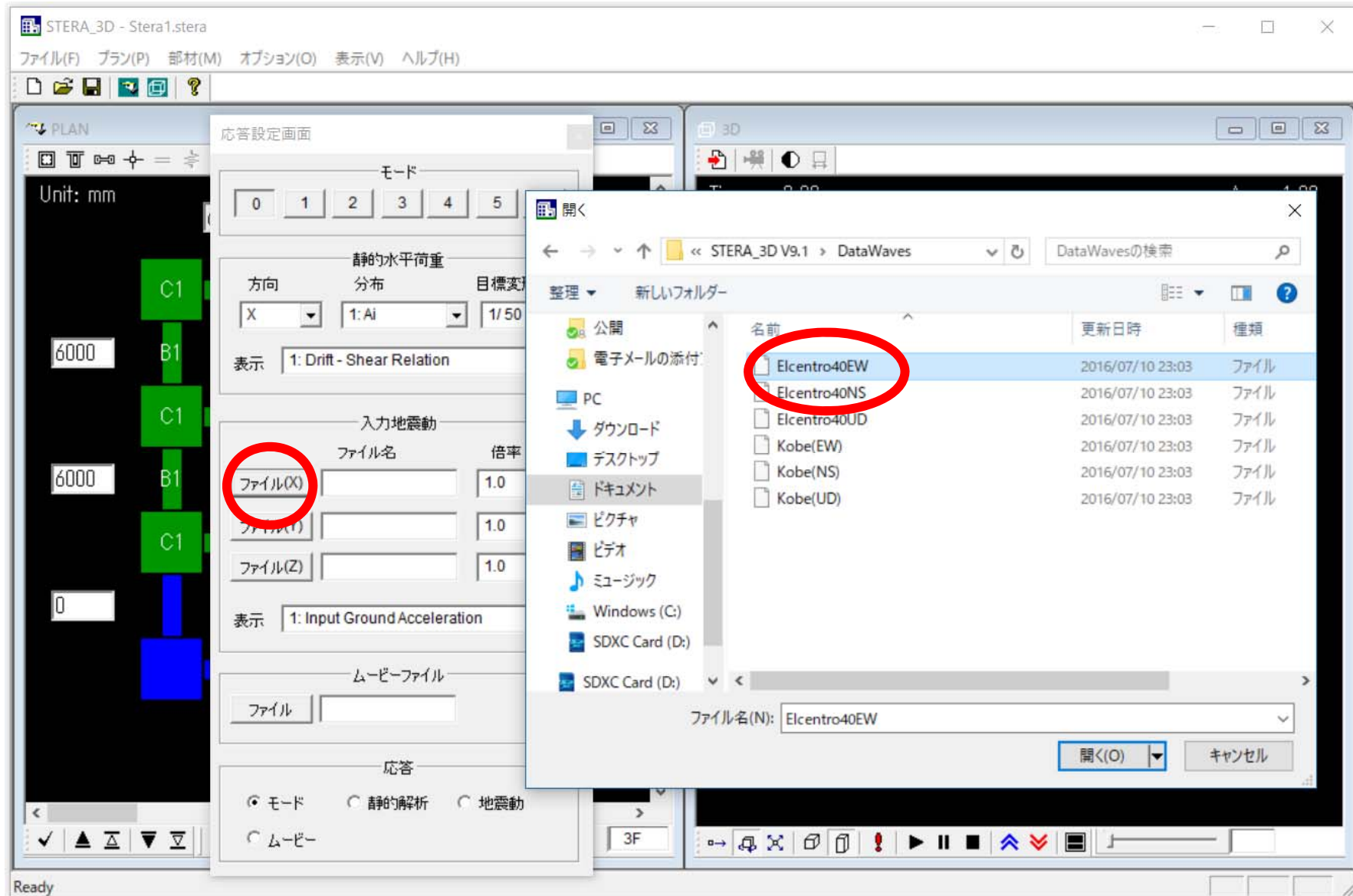
STERA 3D (免震装置を考慮)



STERA 3D (解析)



STERA 3D (地震応答解析)



STERA 3D (地震応答解析)

