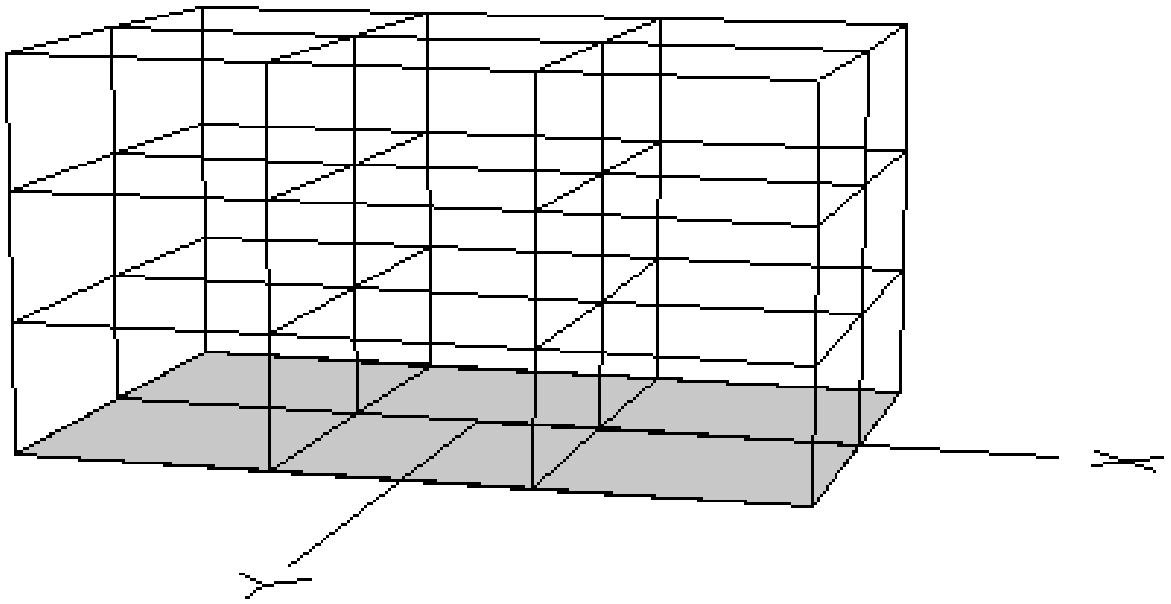
Basic Assumption

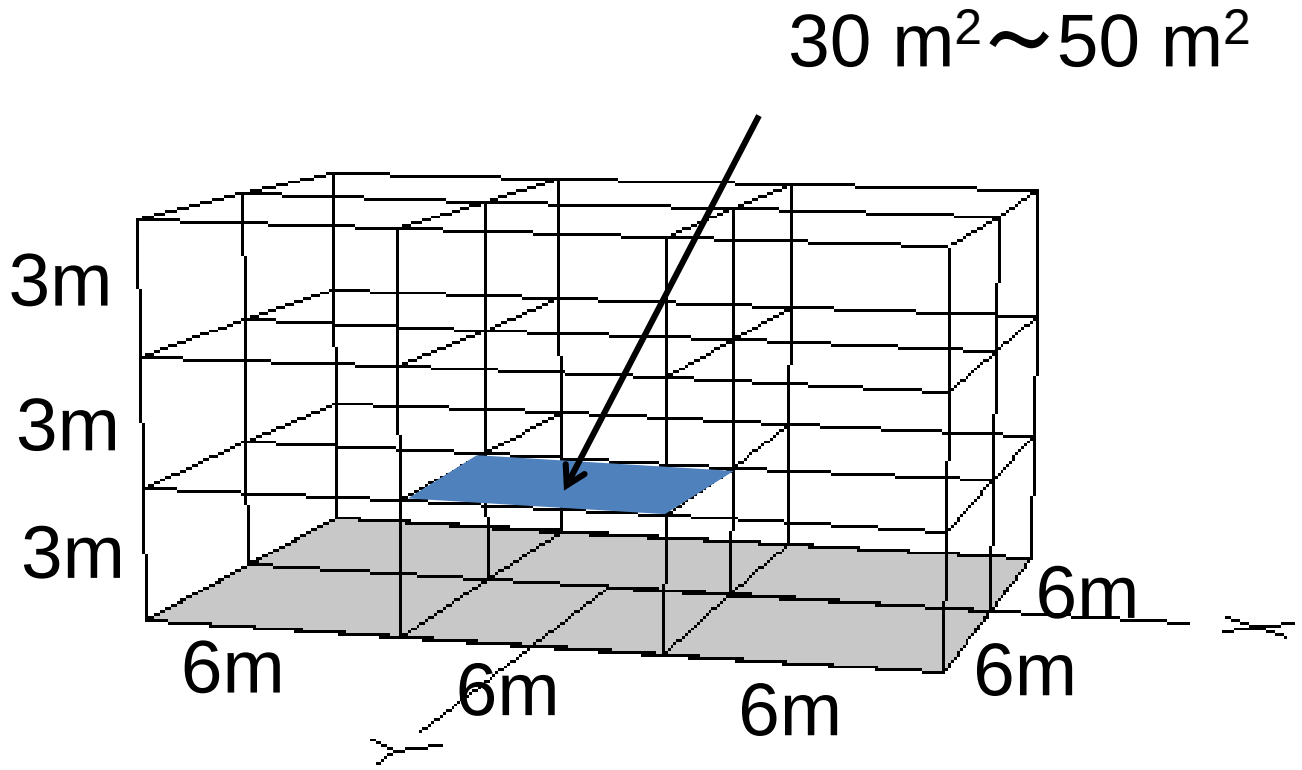
RC (Reinforced Concrete)

3 Story

2 × 3 Span

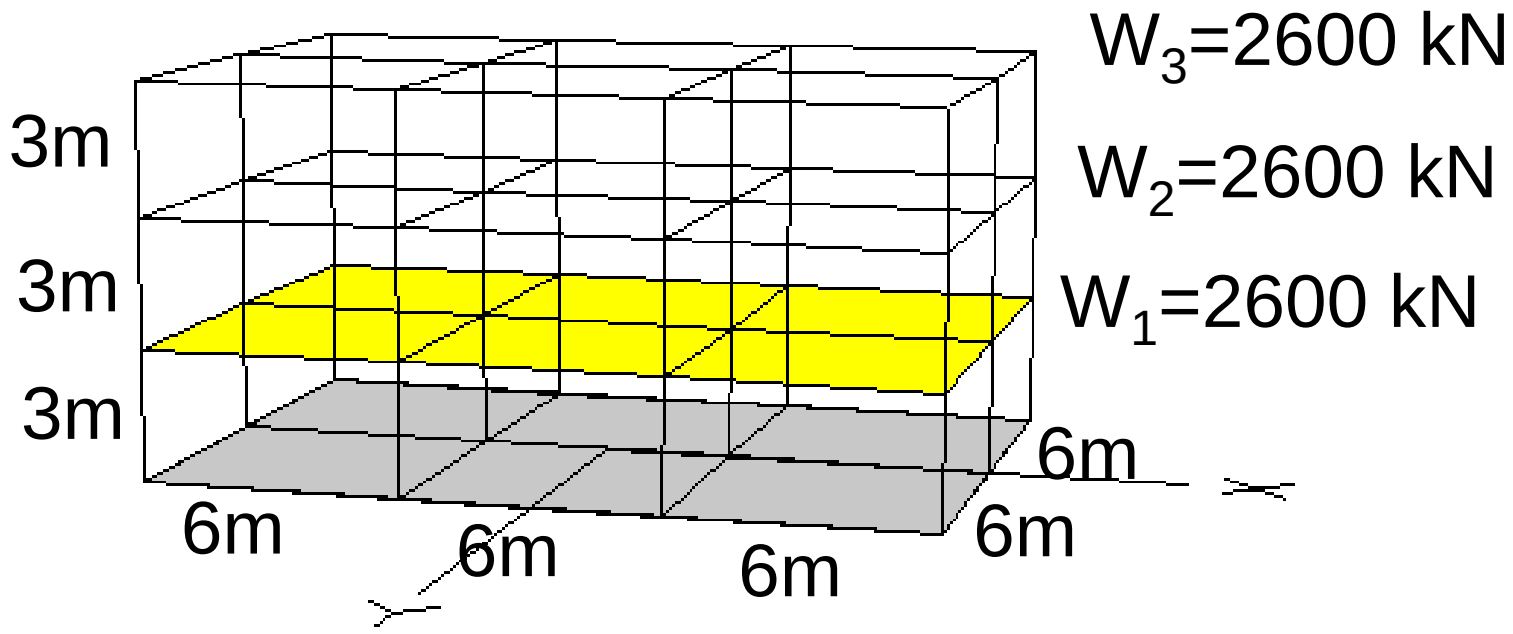


Span



Weight of Building

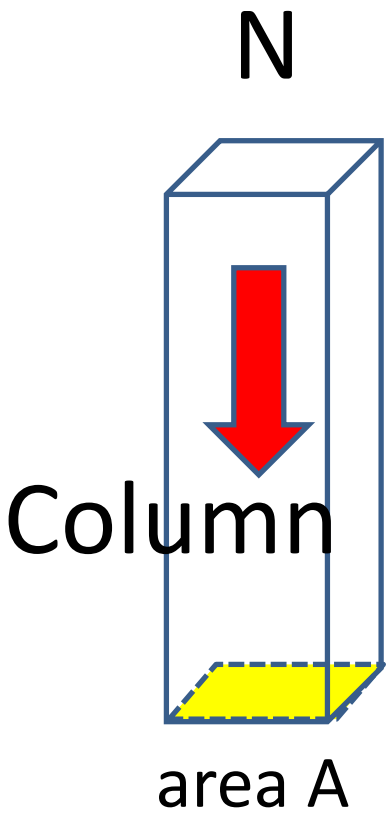
1.2 ton / m^2 ≈ 12 kN / m^2



Concrete Strength

$Fc = 240\ (kg/cm^2)$

$= 24\ (MPa, N/mm^2)$



Axial Load

$N = 0.2\ Fc \times A$

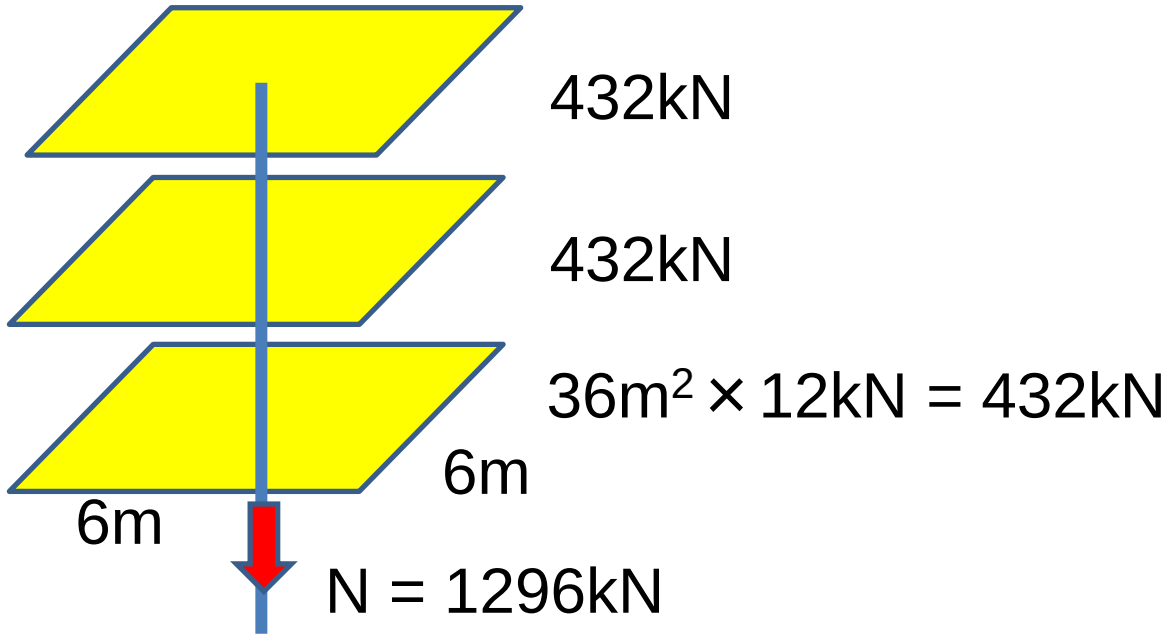
$< (1/3)\ Fc \times A$

Colum Size

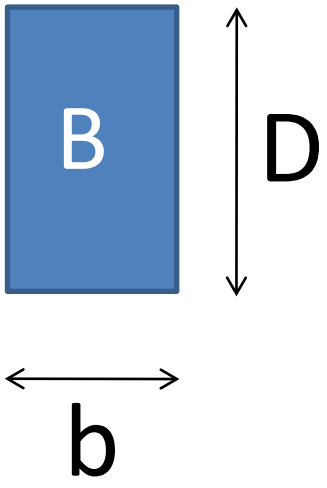
C

$A = N / (0.2Fc) = 1296(kN)/4.8(N/mm^2) = 2700\ (cm^2)$

→ 60cm × 60cm



Beam Size



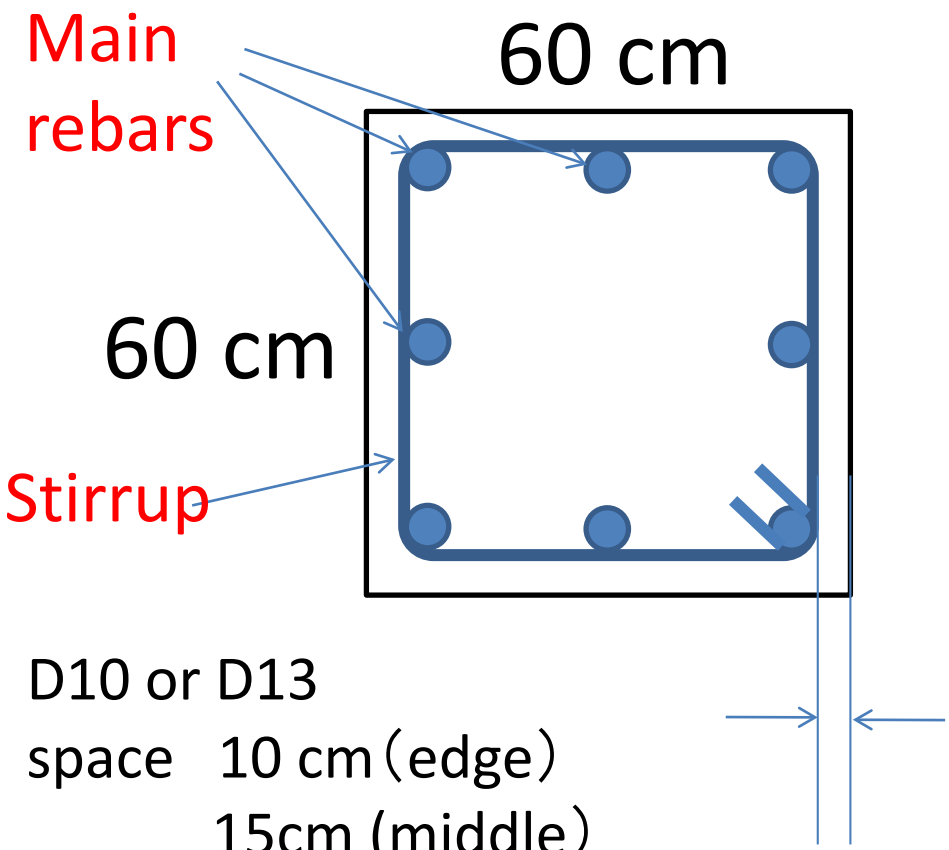
$D \approx (\text{Span}) \times 1/10$

$D = 60\ \text{cm}$

$b \approx D \times 1/2$

$b = 30\ \text{cm}$

Reinforcement in Column

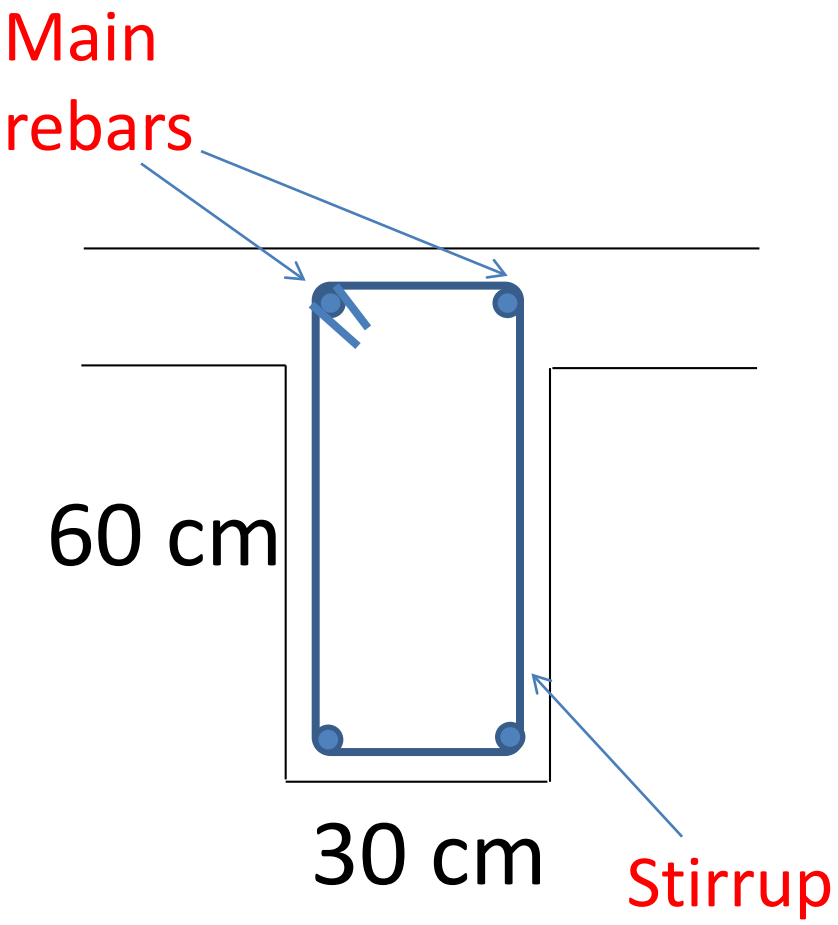


Minimum rebar ratio = $\frac{\text{Total area of rebar}}{\text{Section area}}$

$> 0.8\ \%$

Total area of rebar
$= 3600\text{cm}^2 \times 0.008 = 28.8\ \text{cm}^2$
→ D22 (3.87cm^2) × 8

Reinforcement in Beam



Minimum rebar ratio = $\frac{\text{Tension side rebar area}}{\text{Section area}}$

$> 0.4\ \%$

Total area of rebar

$= 1800\text{cm}^2 \times 0.004 = 7.2\ \text{cm}^2$

→ D22 (3.87cm^2) × 2

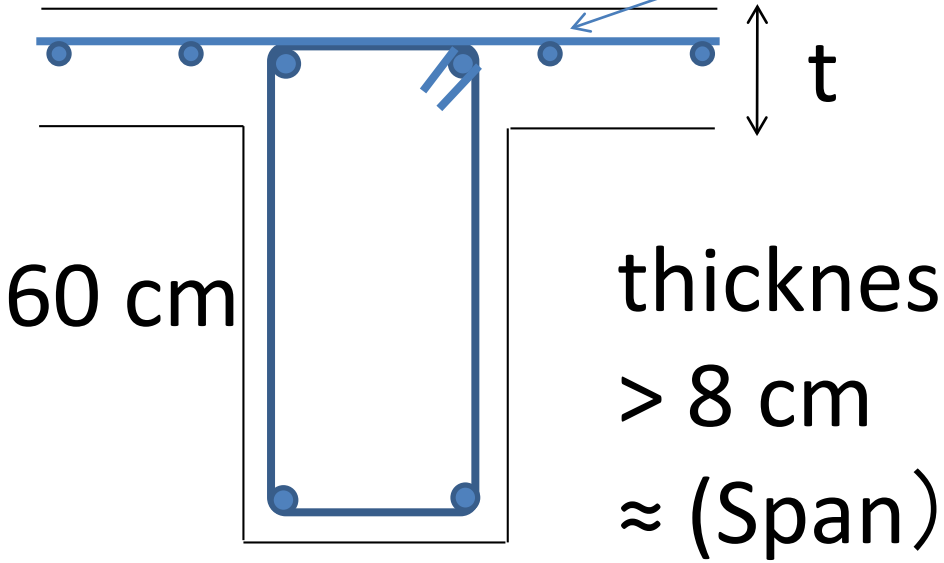
D10 or D13

space 15 cm（edge）

20cm (middle）

→ 2-D13@150

Reinforcement in Slab



D10 or D13

space 20 cm

→ D13 @ 200

thickness: t

> 8 cm

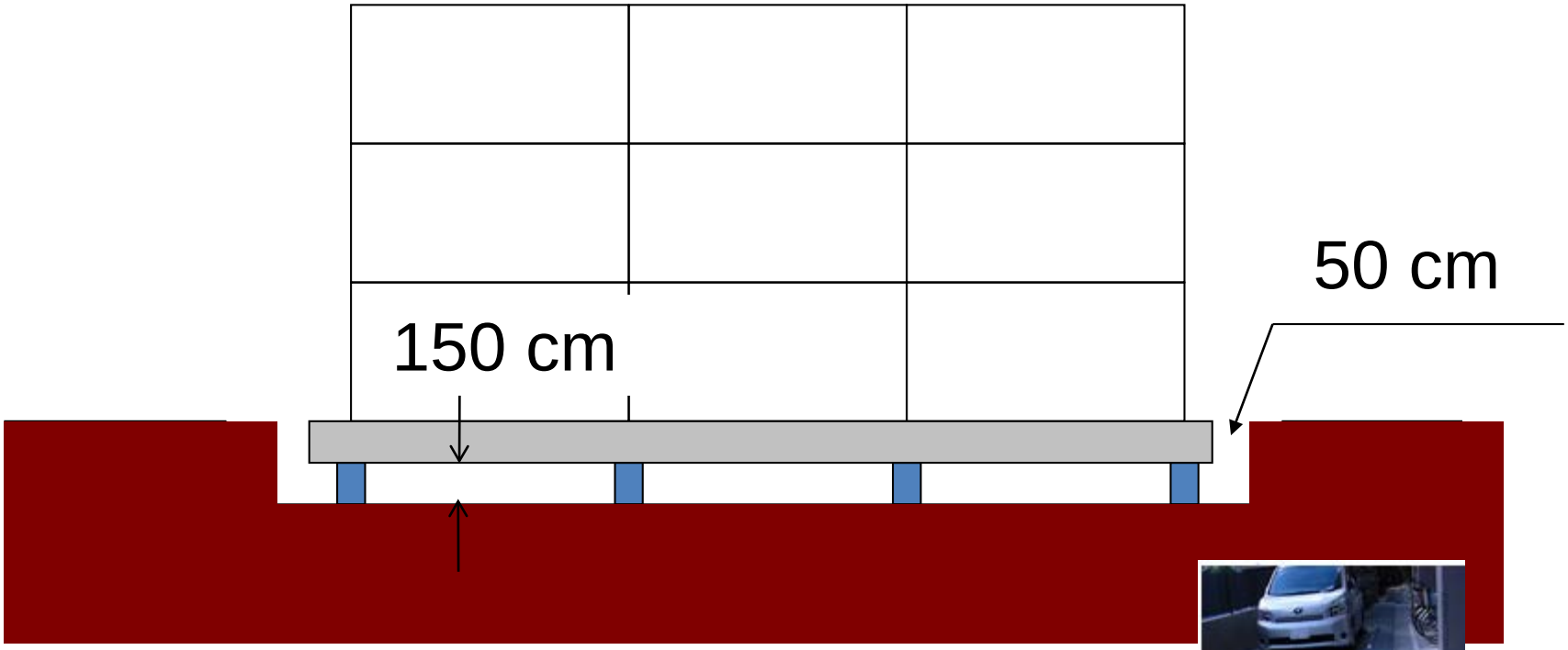
≈ (Span）× 1/40

t = 15 cm

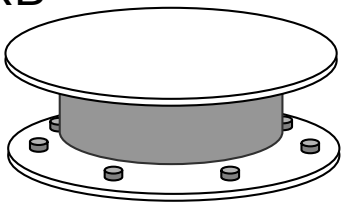
Strength of steel

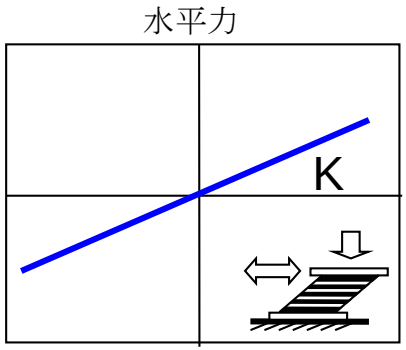
Name	Tensile strength
SD295	3.0 (t/cm^2) = 295 (MPa, N/mm^2)
SD345	3.5 (t/cm^2) = 345 (MPa, N/mm^2)
SD390	4.0 (t/cm^2) = 390 (MPa, N/mm^2)

Design of Base Isolation Layer

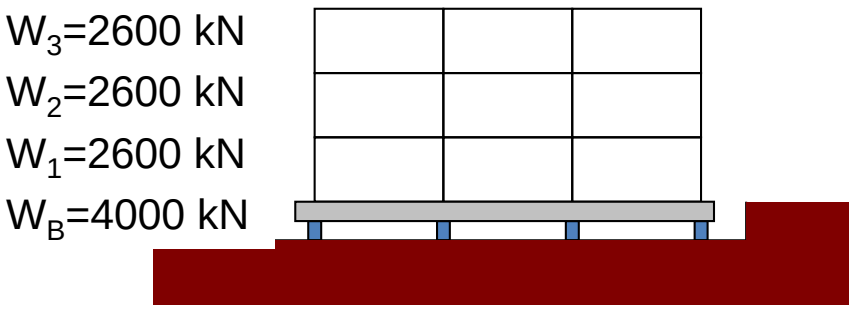


Natural Rubber Bearing
NRB

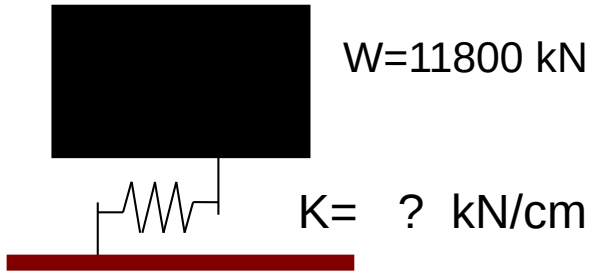




Design of Base Isolation Period



≈



Period Mass Weight

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

Gravity acc.

$g = 980 cm/sec^2$

Target Period

T = 4 sec

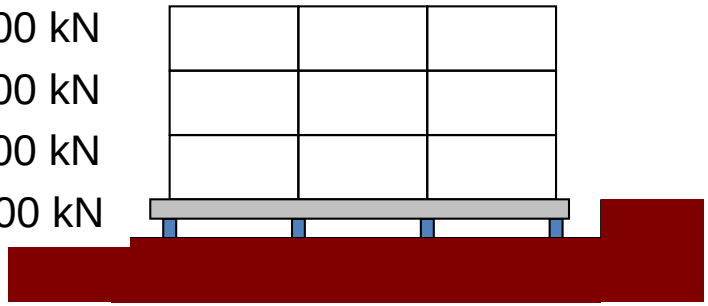
Stiffness

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

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

Stiffness of isolator

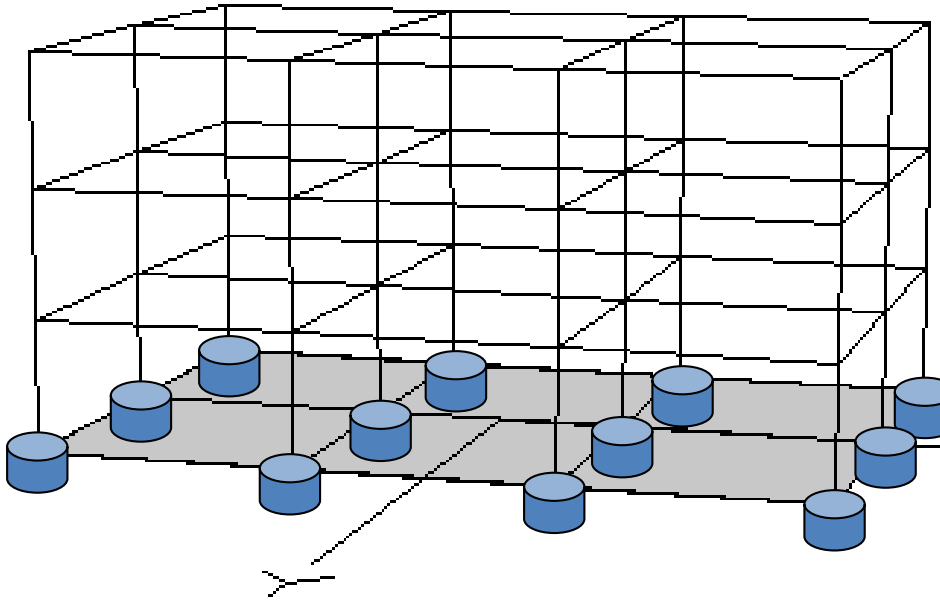
W_3=2600 kN
W_2=2600 kN
W_1=2600 kN
W_B=4000 kN



≈

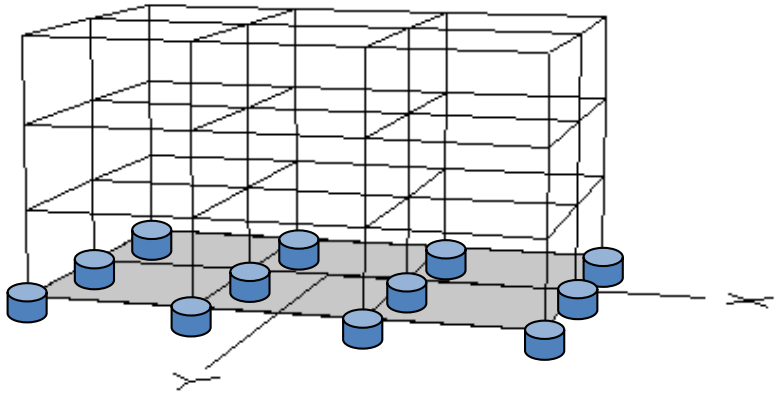
W=11800 kN

K= 30 kN/cm

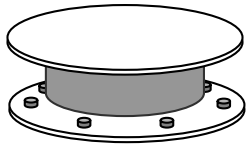


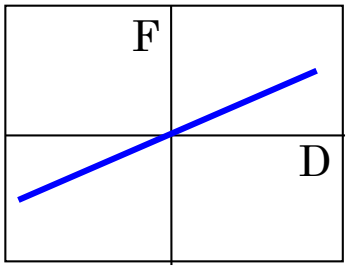
k = K / 12
= 2.5 kN/cm
= 0.25 kN/mm

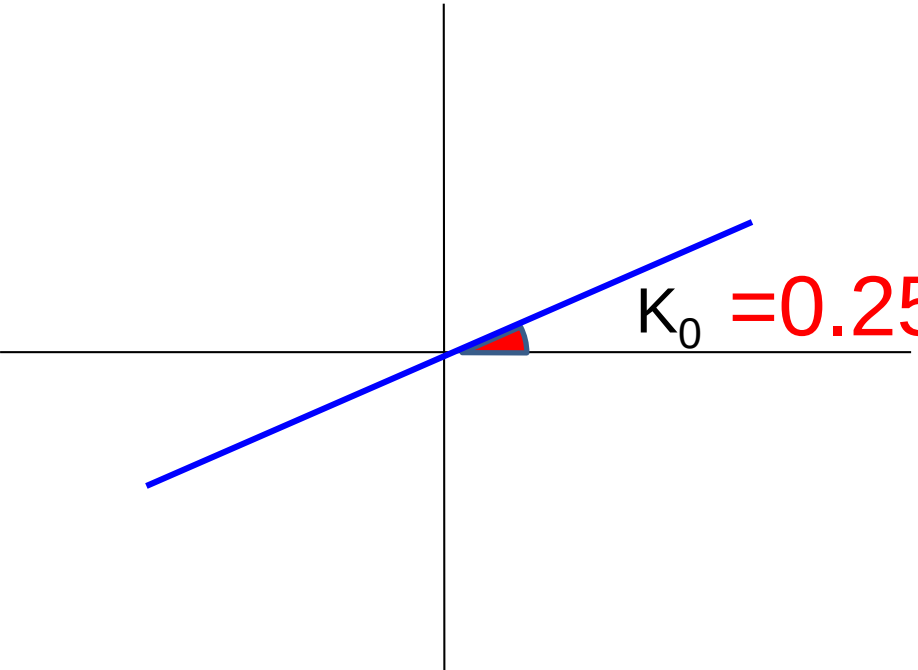
Stiffness of isolator



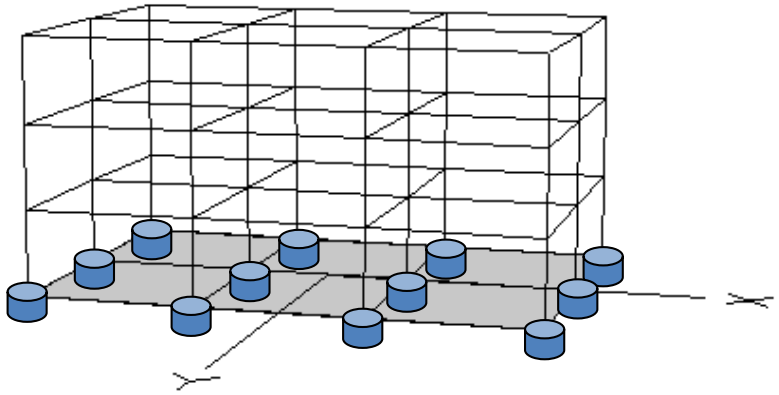
Natural Rubber
Bearing (NRB)



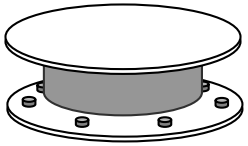


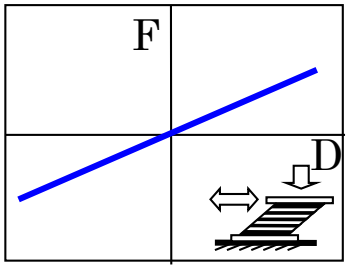


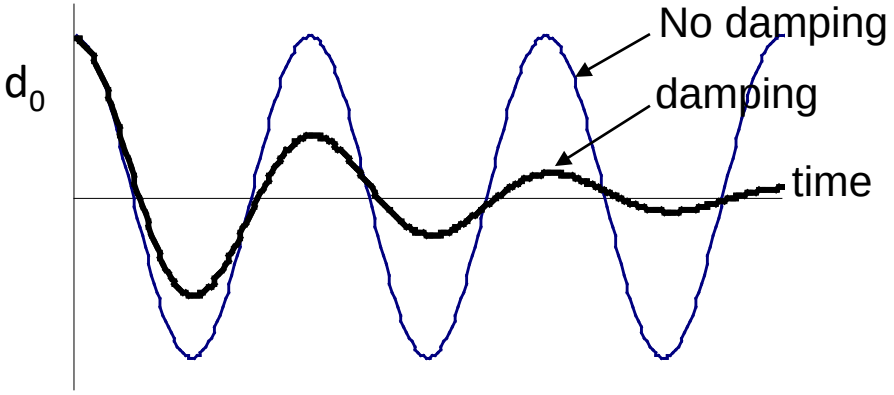
Design of damper

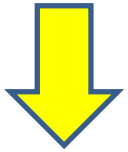


Natural Rubber
Bearing (NRB)



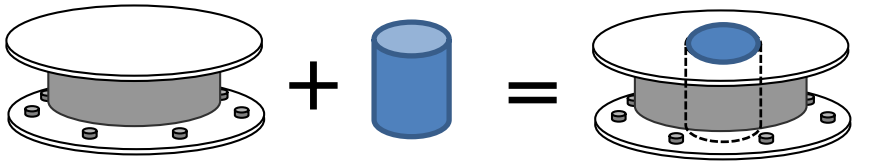


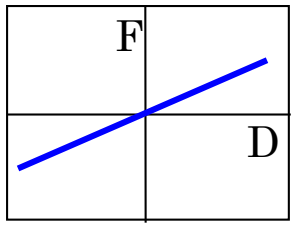


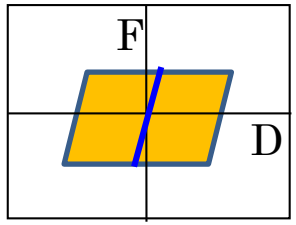


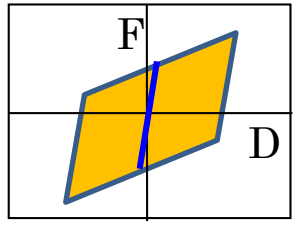
Lead

Lead Rubber
Bearing (LRB)

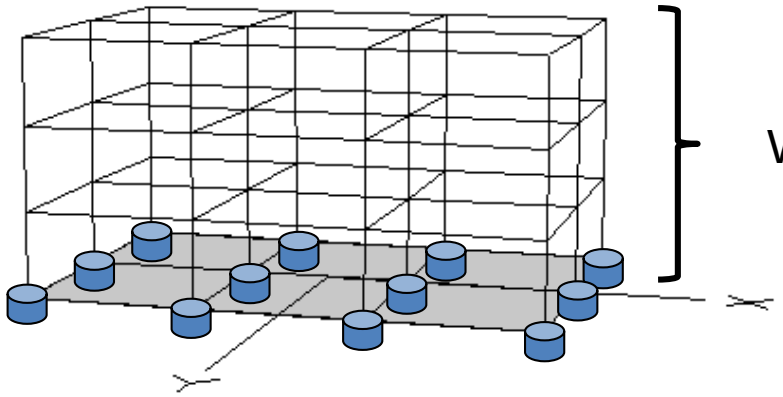




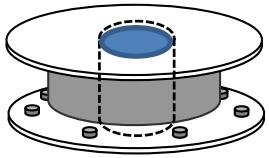




Lead Rubber Bearing



W=11800 kN



Fy ≈ 100 kN

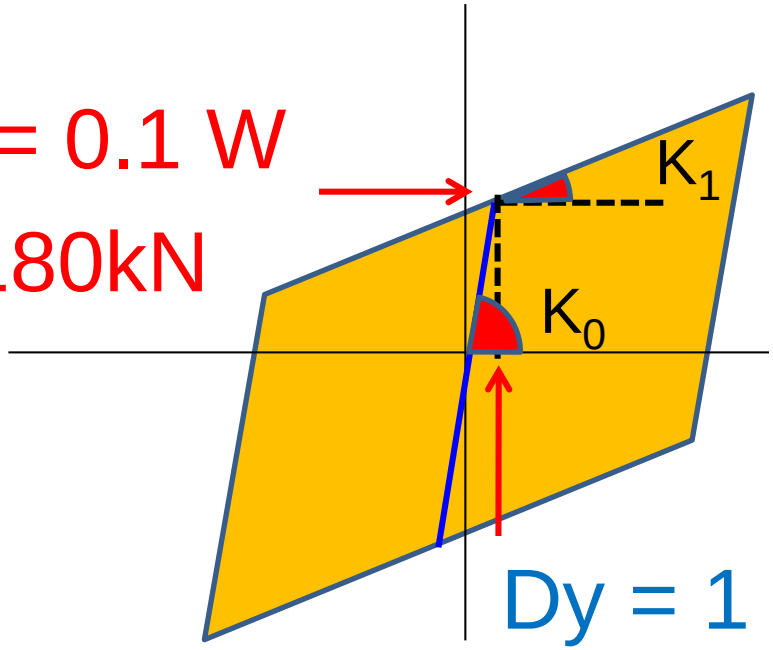
K_0 ≈ 10 kN/mm

K_1 / K_0 ≈ 0.025

1/12

Fy = 0.1 W

=1180kN

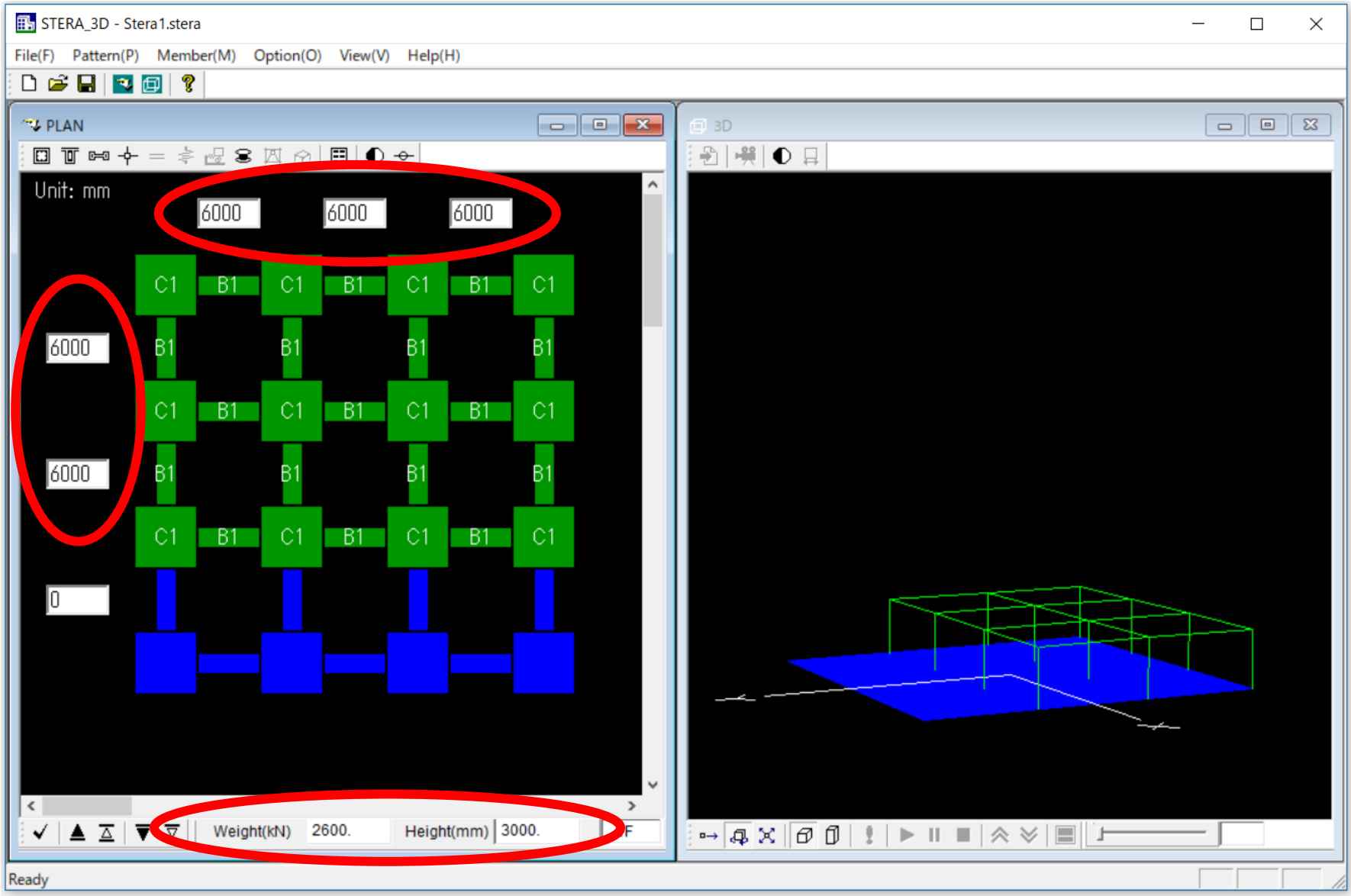


K_1 = 30 kN/cm

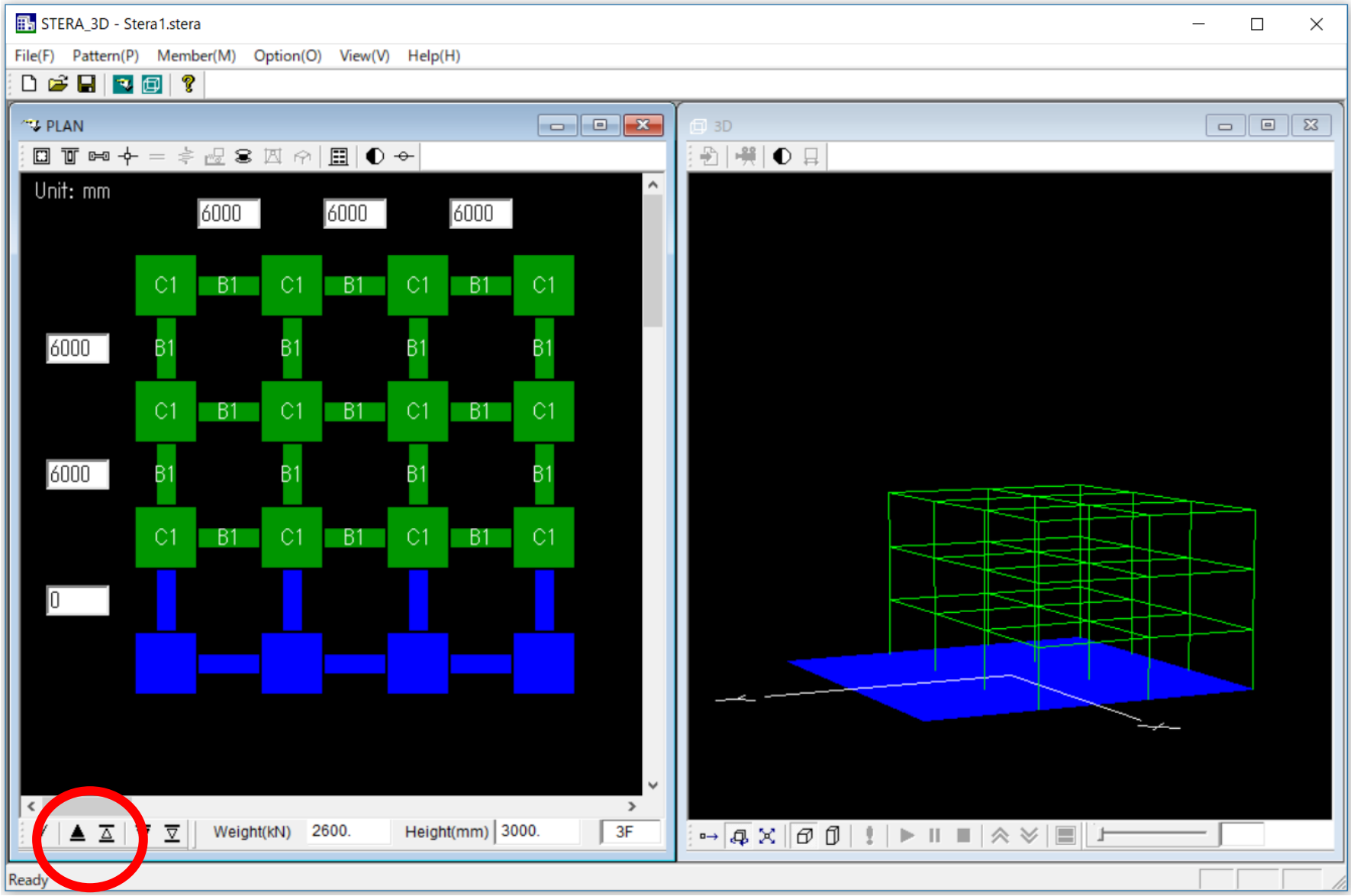
K_0 = 1180 kN/cm

K_1 / K_0 ≈ 0.025

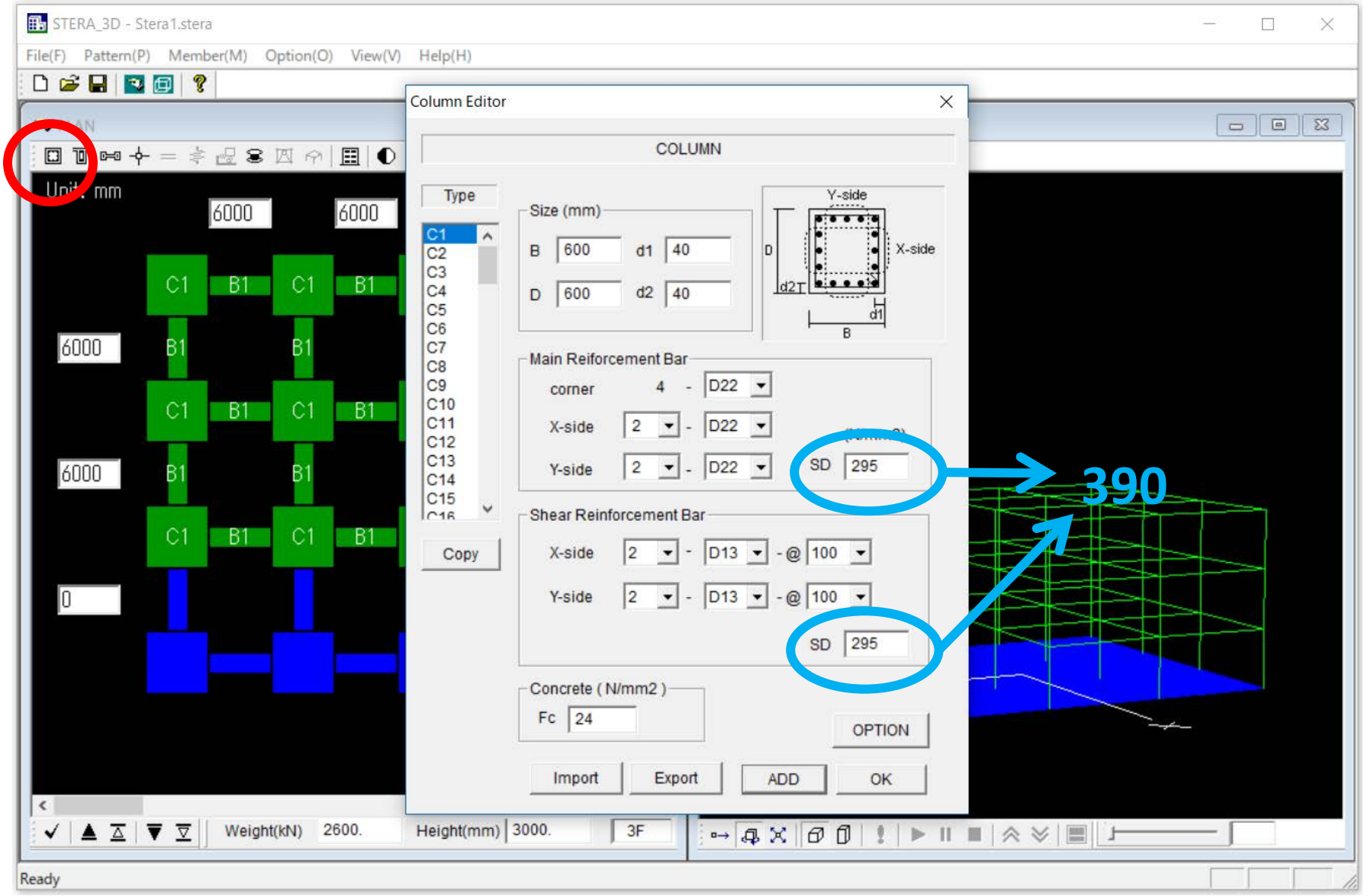
STERA 3D (Input of Size)



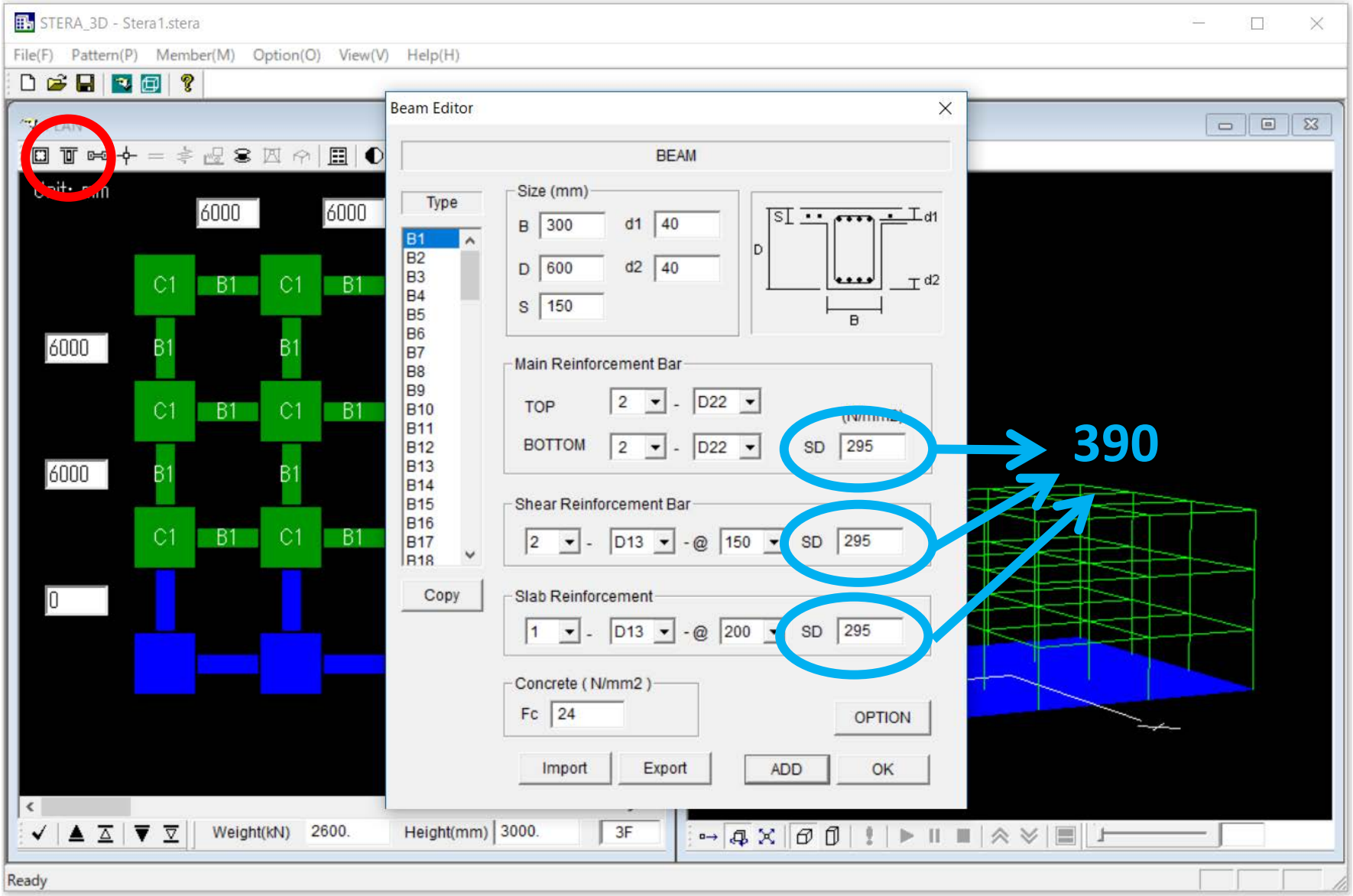
STERA 3D (Upper floor, copy)



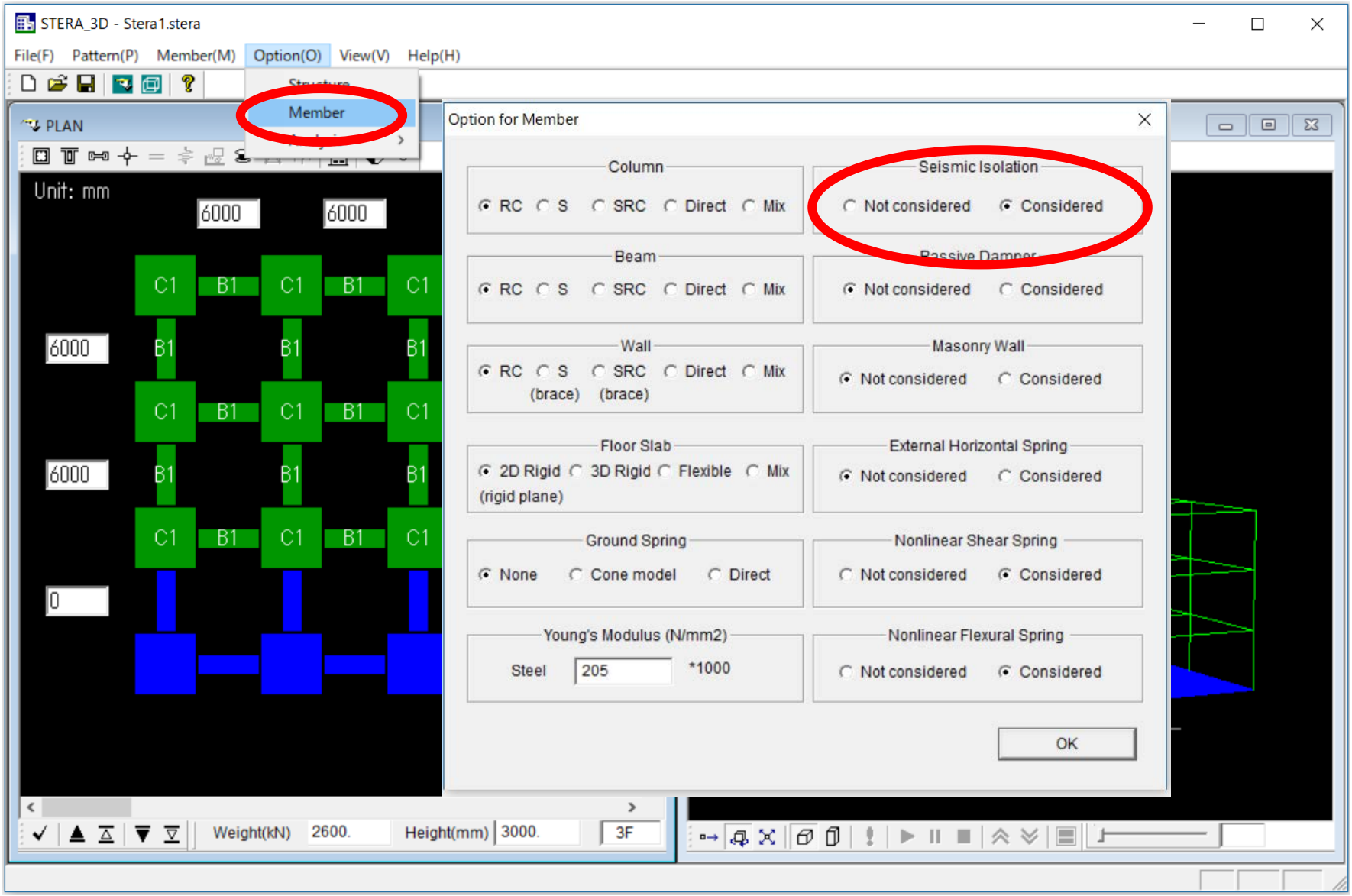
STERA 3D (Column Input)



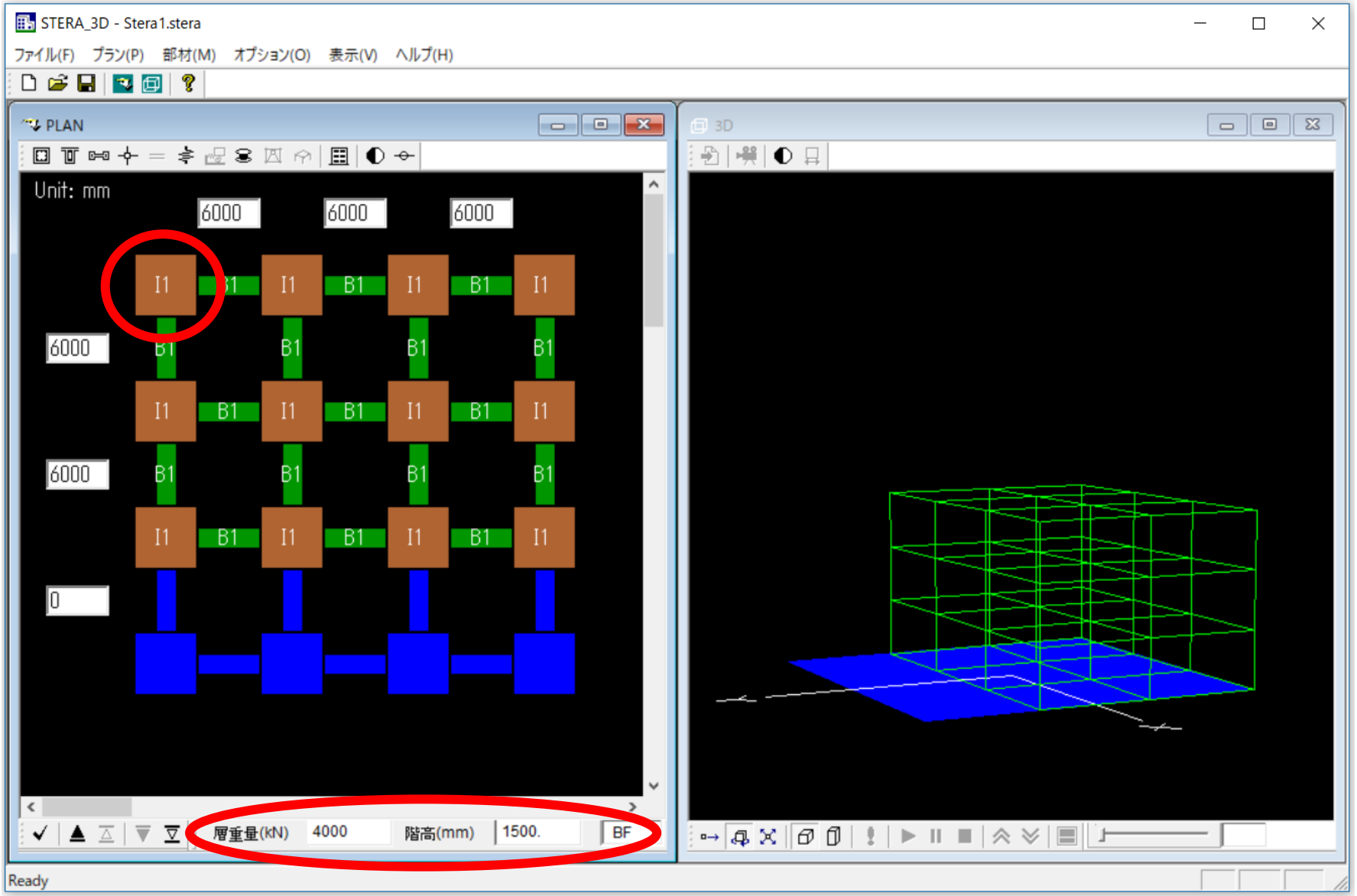
STERA 3D (Beam Input)



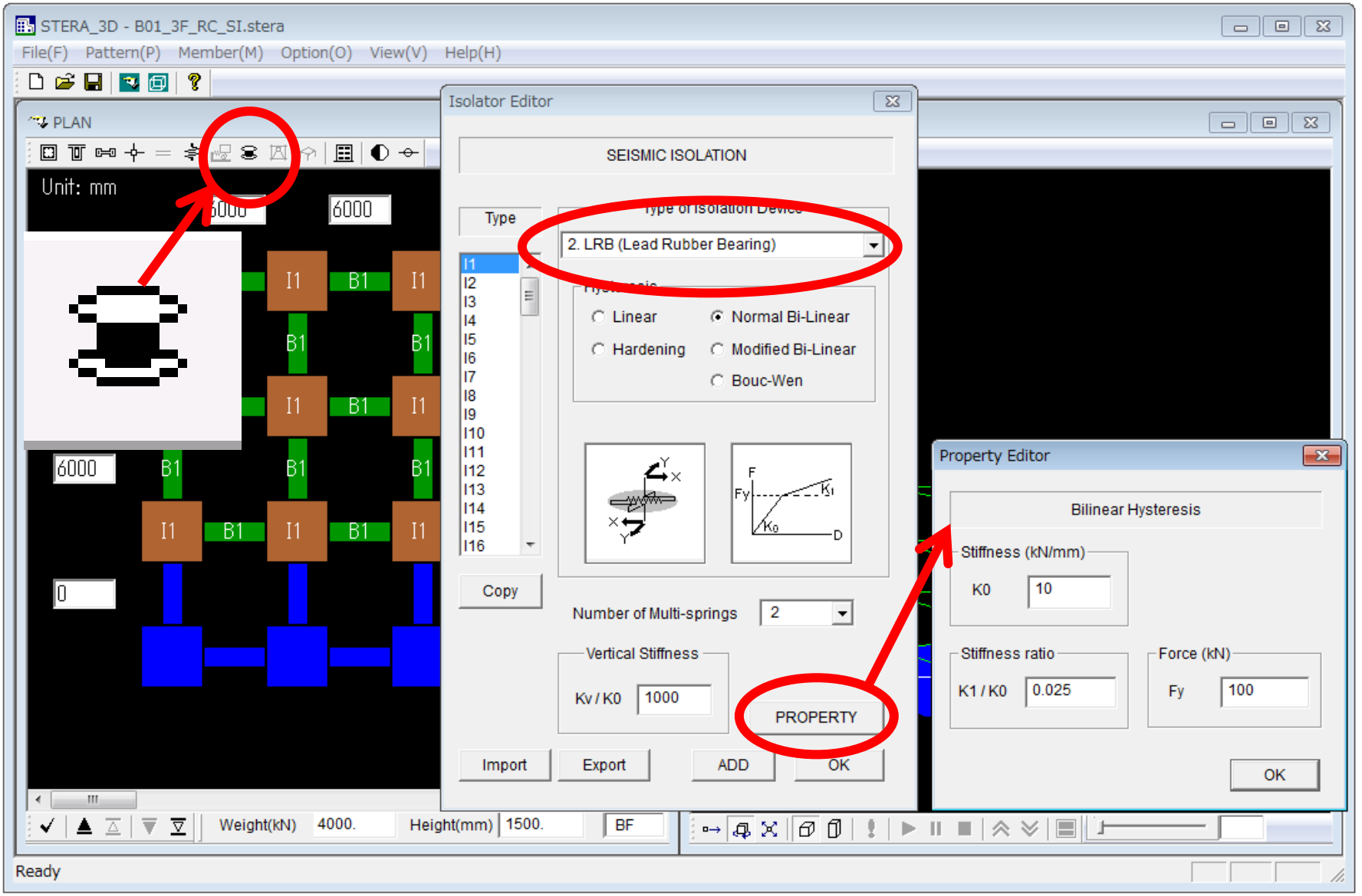
STERA 3D (consider Isolation)



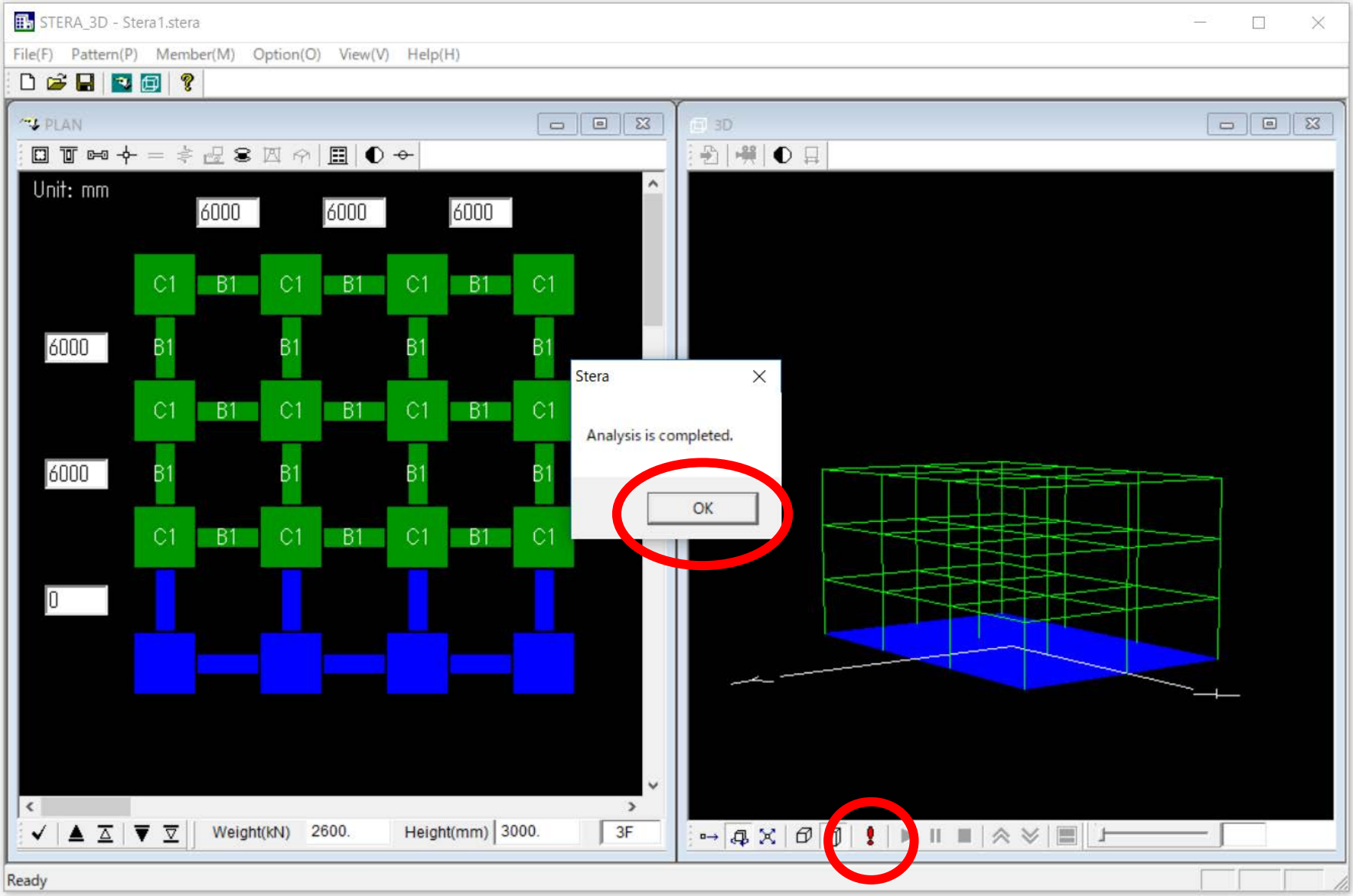
STERA 3D (setting SI member)



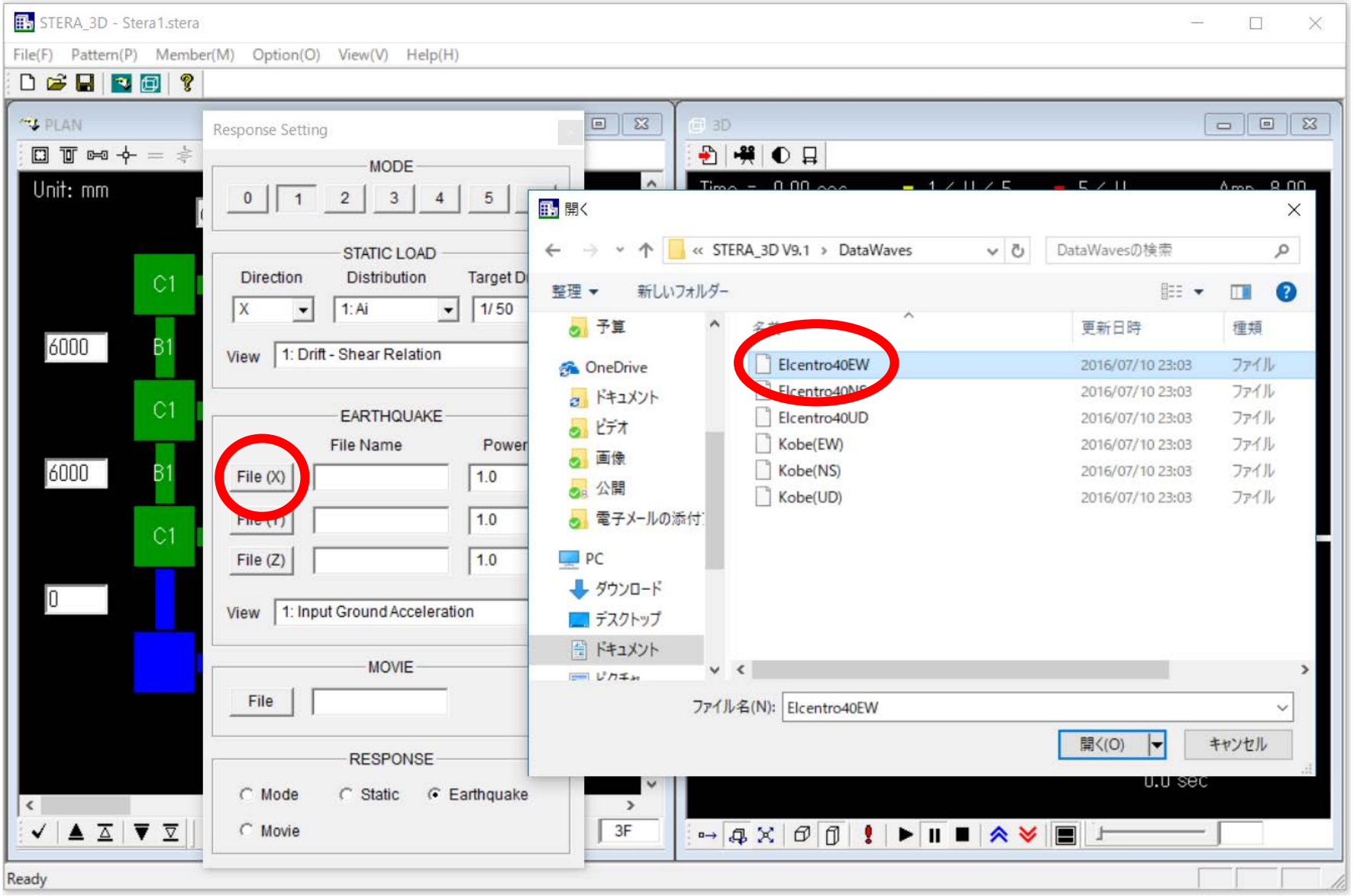
STERA 3D (SI devise)



STERA 3D (Analyze)



STERA 3D (Earthquake Response)



STERA 3D (Earthquake Response)