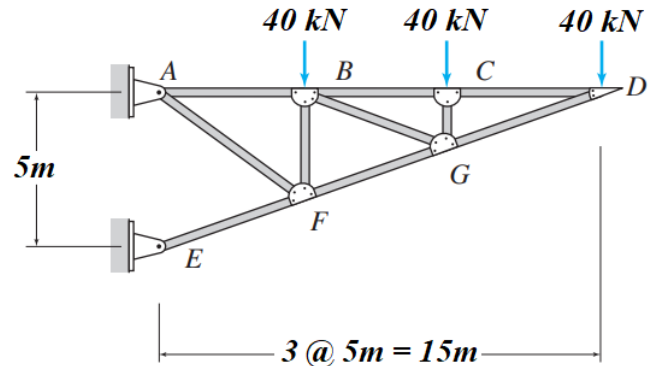
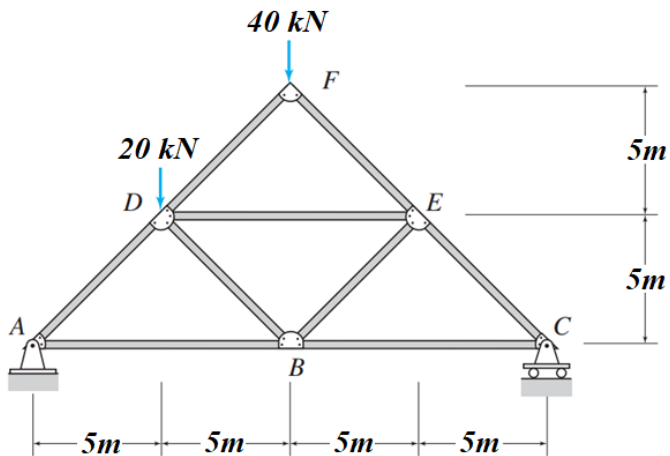
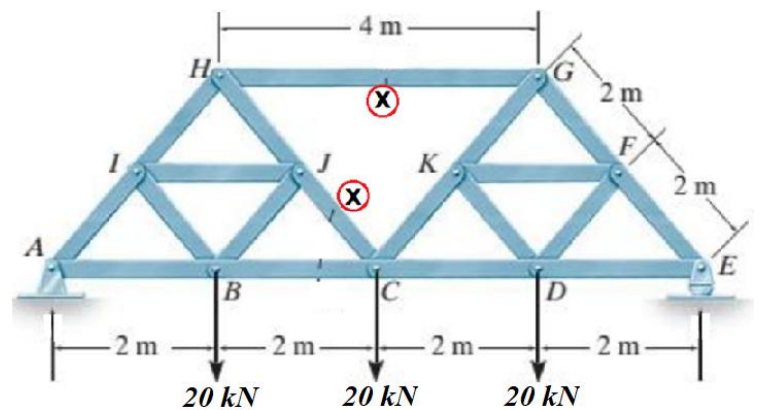
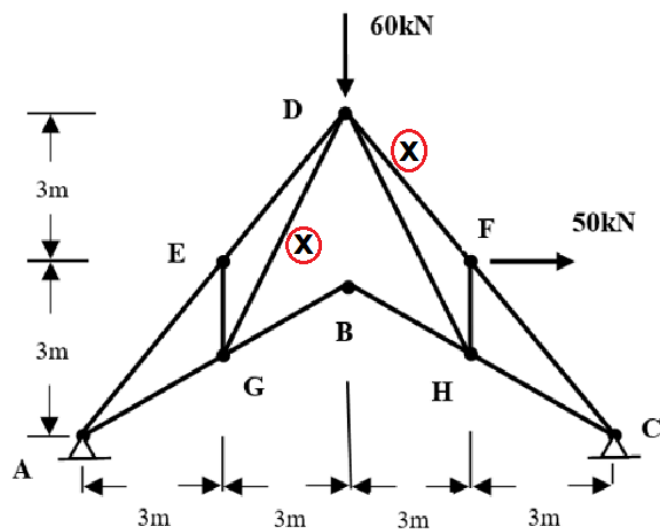


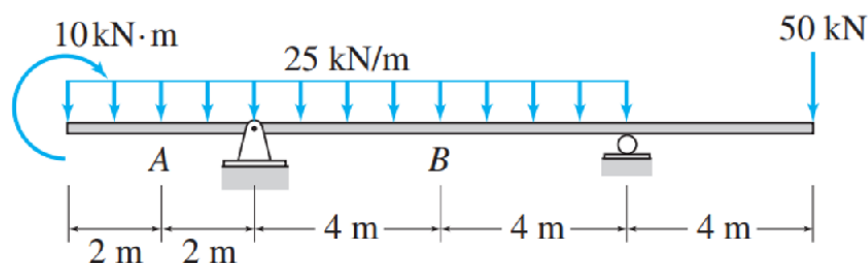
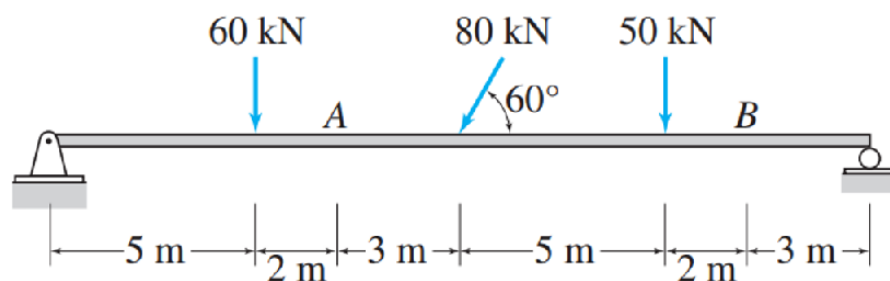
1) Determine the force in all the members of the two trusses shown.



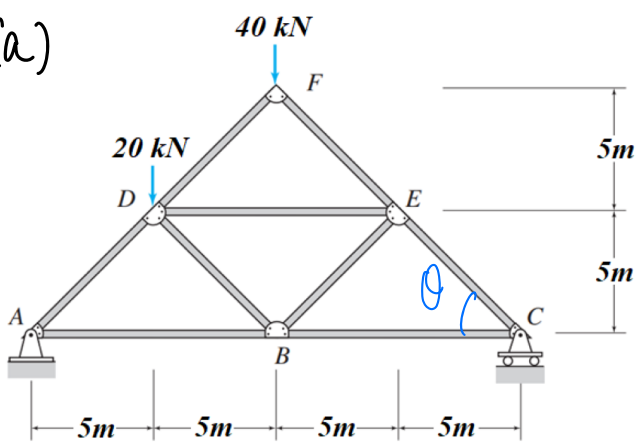
2) Determine the force in the members identified by the letter 'x' in each of trusses shown.



3) Analyse the following beams, and draw the shear force and bending moment diagrams.



1 (a)

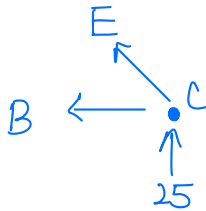


$$\tan \theta = \frac{5}{5}$$
$$\theta = 45^\circ$$

$$\Sigma M_A = 0, \quad C_y = \frac{20 \times 5 + 40 \times 10}{20} = 25 \text{ kN}$$

$$A_y = 40 + 20 - 25 = 35 \text{ kN}$$

Point C:

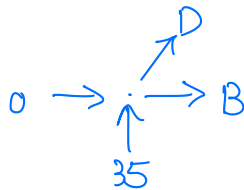


$$\begin{aligned}\sum F_y &= 0, & CE \sin \theta + 25 &= 0 \\ & & CE &= -25\sqrt{2} \\ & & &= 25\sqrt{2} \text{ kN (comp.)}\end{aligned}$$

$$\sum F_x = 0, \quad CB + CE \cos \theta = 0$$

$$CB = 25 \text{ kN (tens.)}$$

Point A :

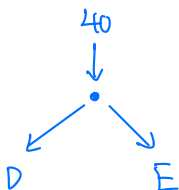


$$\begin{aligned}\sum F_y &= 0, \quad AD \sin \theta + 35 = 0 \\ AD &= -35\sqrt{2} \\ &= 35\sqrt{2} \text{ kN (comp.)}\end{aligned}$$

$$\Sigma F_x = 0, \quad AB + AD \cos \theta = 0$$

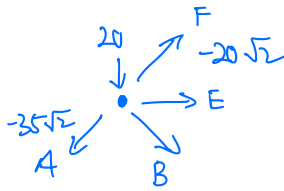
$$AB = 35 \text{ kN (tens.)}$$

Point F,



$$\begin{aligned}\sum F_x &= 0, & FD &= FE \\ \sum F_y &= 0, & FD \sin \theta + FE \sin \theta + 40 &= 0 \\ & & FD &= FE = -20\sqrt{2} \\ & & &= 20\sqrt{2} \text{ (comp.)}\end{aligned}$$

Point D :



$$\sum F_y = 0, \quad 35\sqrt{2} \sin\theta - 20 - DB \sin\theta - 20\sqrt{2} \sin\theta = 0$$

$$DB = -5\sqrt{2}$$

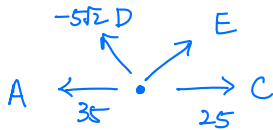
$$= 5\sqrt{2} \text{ kN (comp.)}$$

$$\sum F_x = 0, \quad 35\sqrt{2} \cos\theta - 5\sqrt{2} \cos\theta + DE - 20\sqrt{2} \cos\theta = 0$$

$$DE = -10$$

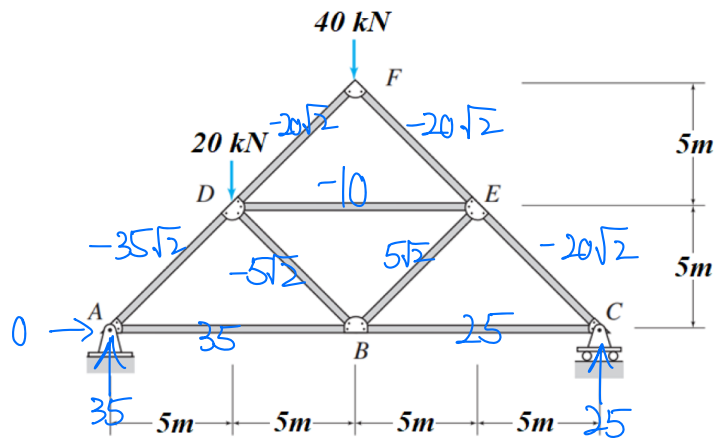
$$= 10 \text{ kN (comp.)}$$

Point B :

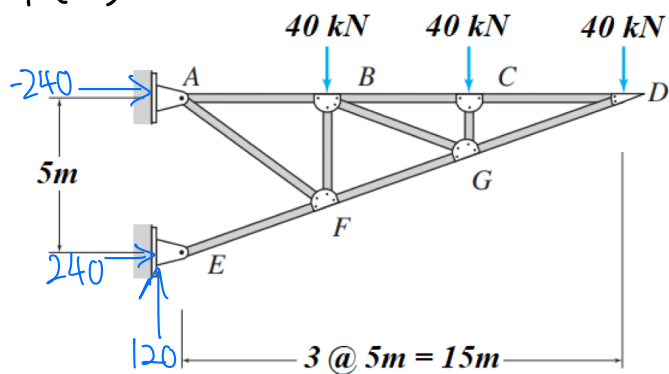


$$\sum F_y = 0, \quad -5\sqrt{2} \sin\theta + E \sin\theta = 0$$

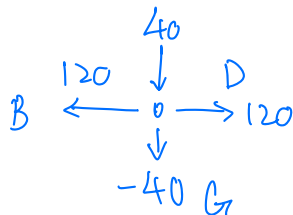
$$E = 5\sqrt{2} \text{ kN (tens.)}$$



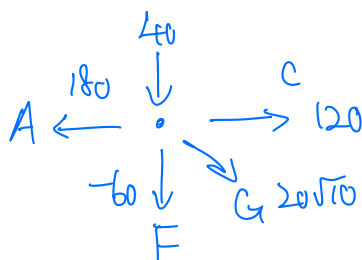
1 (b)



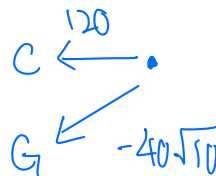
C :



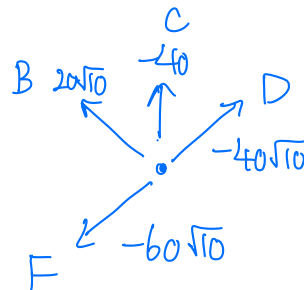
B :



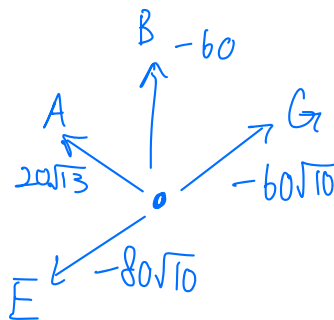
D :



G :



F :



$$AB = 180 \text{ kN (tens.)}$$

$$AF = 20\sqrt{13} \text{ kN (tens.)}$$

$$BF = 60 \text{ kN (comp.)}$$

$$BC = 120 \text{ kN (tens.)}$$

$$BG = 20\sqrt{10} \text{ kN (tens.)}$$

$$CG = 40 \text{ kN (comp.)}$$

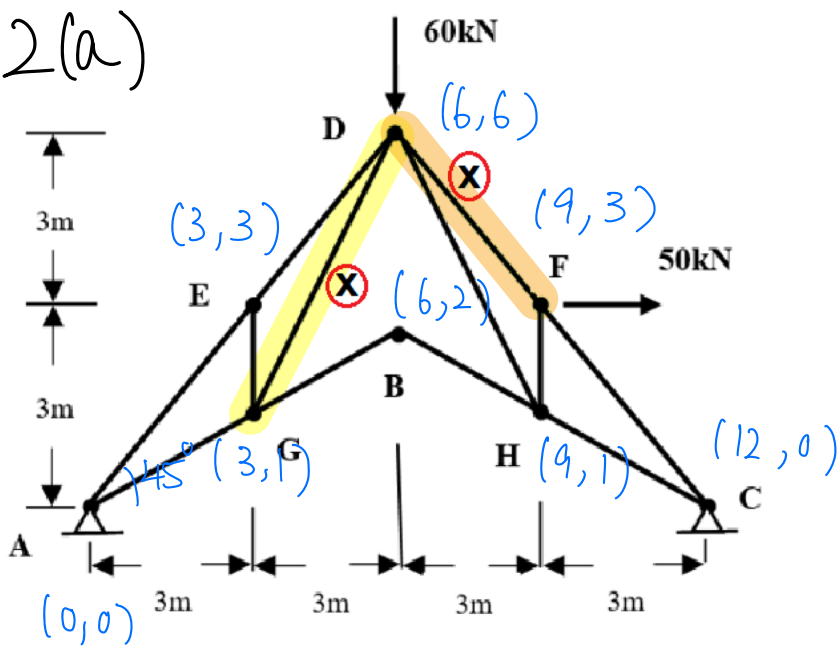
$$CD = 120 \text{ kN (tens.)}$$

$$EF = 80\sqrt{10} \text{ kN (comp.)}$$

$$FG = 60\sqrt{10} \text{ kN (comp.)}$$

$$GD = 40\sqrt{10} \text{ kN (comp.)}$$

2(a)



$$\sum M_A = 0,$$

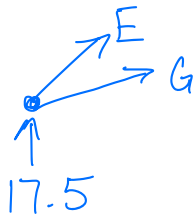
$$12C_y - 60 \times 6 - 50 \times 3 = 0$$

$$C_y = 42.5 \text{ kN } \uparrow$$

$$A_y = 60 - 42.5 = 17.5 \text{ kN } \uparrow$$

$$A_x = 50 \text{ kN } \leftarrow$$

Point A:



$$\sum F_y = 0, \quad 17.5 + F_{AE} \sin 45^\circ + F_{AG} \sin 18.4^\circ = 0$$

$$\frac{\sqrt{2}}{2} F_{AE} + F_{AG} \sin 18.4^\circ = -17.5 \quad \text{--- ①}$$

$$\sum F_x = 0, \quad -50 + \frac{\sqrt{2}}{2} F_{AE} + F_{AG} \cos 18.4^\circ = 0$$

$$\frac{\sqrt{2}}{2} F_{AE} + F_{AG} \cos 18.4^\circ = 50 \quad \text{--- ②}$$

$\sum F_x = 0, \quad -\frac{50}{4} + F_{AG} \cos 18.4^\circ + F_{AD} \cos 51.9^\circ = 0$
 $F_{AG} \cos 18.4^\circ + F_{AD} \cos 51.9^\circ = \frac{50}{4} \quad \text{--- ①}$
 $\sum F_y = 0, \quad -\frac{17.5}{4} + F_{AG} \sin 18.4^\circ + F_{AD} \sin 51.9^\circ = 0$
 $F_{AG} \sin 18.4^\circ + F_{AD} \sin 51.9^\circ = \frac{17.5}{4} \quad \text{--- ②}$
 $\therefore F_{AG} = \frac{135\sqrt{10}}{4}, \quad F_{AD} = \frac{135}{10}$

$$F_{AE} = -\frac{205\sqrt{2}}{4} = \frac{205\sqrt{2}}{4} \text{ kN (comp.)}$$

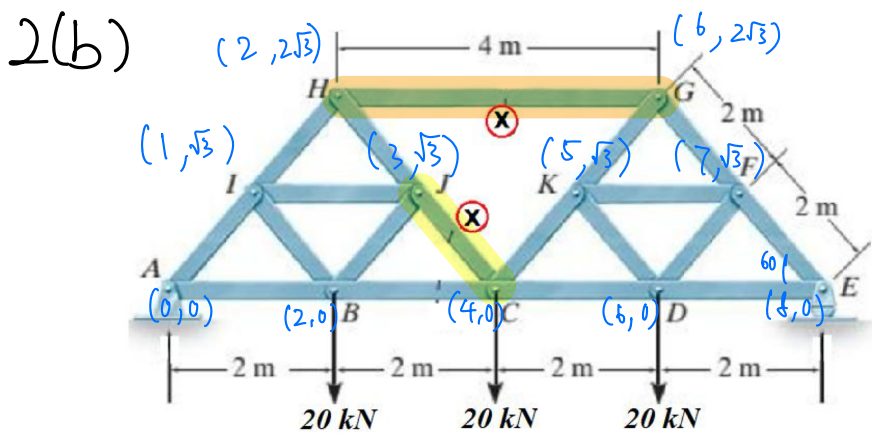
$$F_{AG} = \frac{135\sqrt{10}}{4} \text{ kN (tens.)}$$

$$F_{GD} = 0 \text{ kN}$$

$\therefore$ zero-force members

$$-\frac{255}{4} - \frac{\sqrt{2}}{2} F_{FD} + 50 = 0$$

$$F_{FD} = \frac{55\sqrt{2}}{4} \text{ kN}$$



$$A_y = E_y = 30 \text{ kN} \uparrow$$

$$\sum M_J = 0, \quad -30 \times 3 + 20 - \sqrt{3} F_{HG} = 0$$

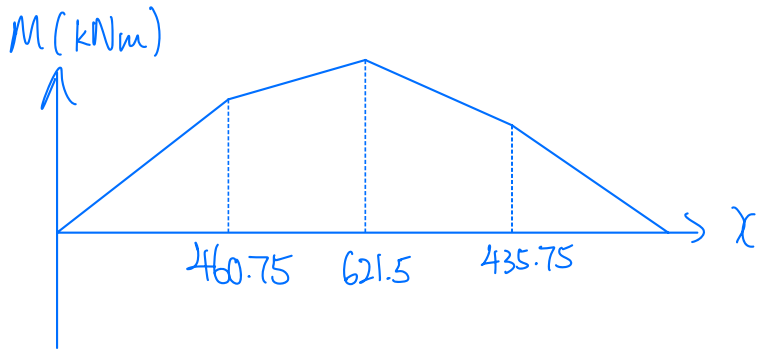
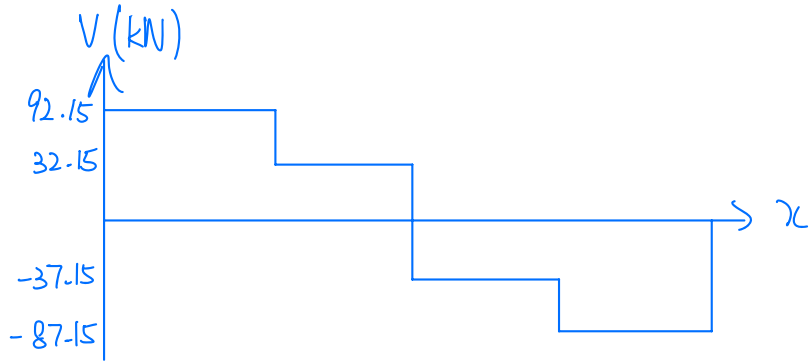
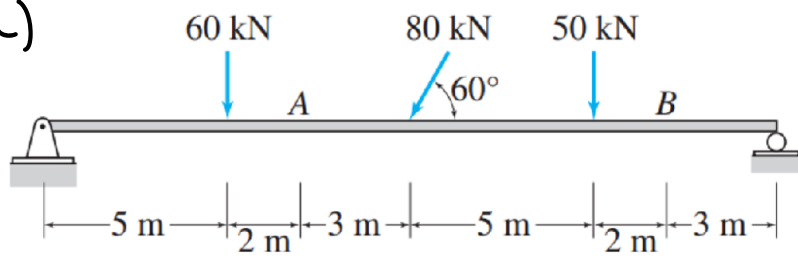
$$F_{HG} = -\frac{70\sqrt{3}}{3}$$

$$= \frac{70\sqrt{3}}{3} \text{ kN (comp.)}$$

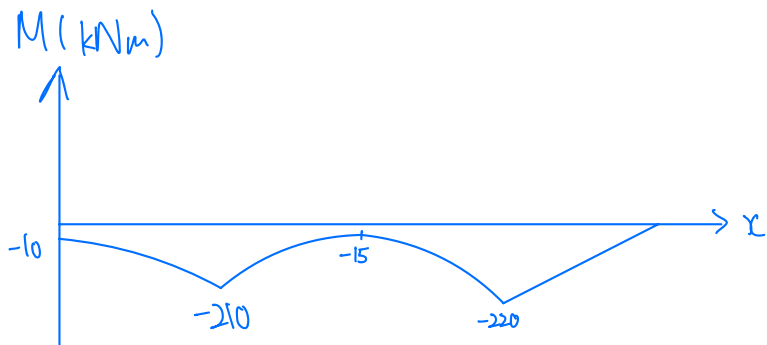
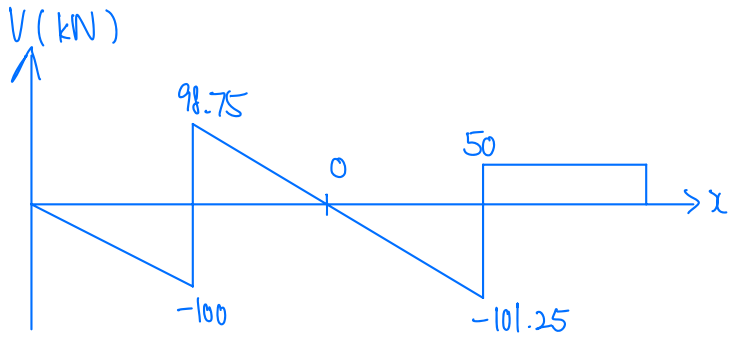
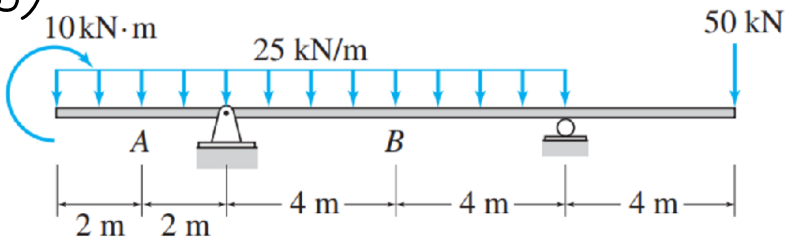
$$\sum M_K = 0, \quad 30 \times 3 - 20 + 20 + \frac{70}{\sqrt{3}} \times -\sqrt{3} - \sqrt{3} F_{JC} = 0$$

$$F_{JC} = \frac{20\sqrt{3}}{3} \text{ kN (tens.)}$$

3(a)

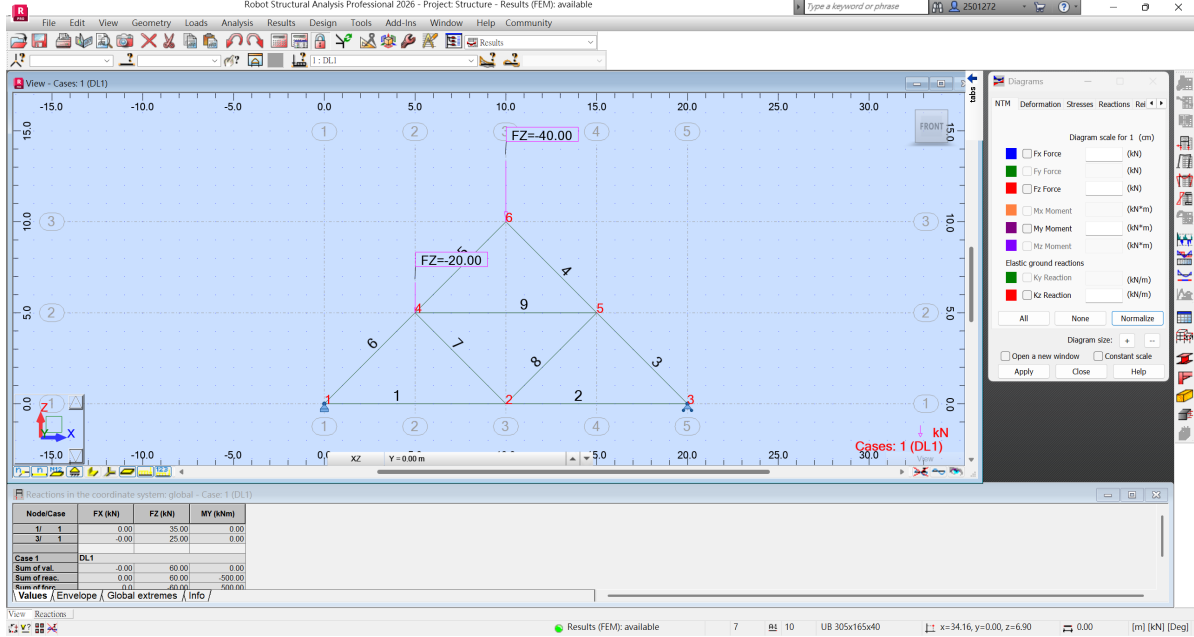


3(b)

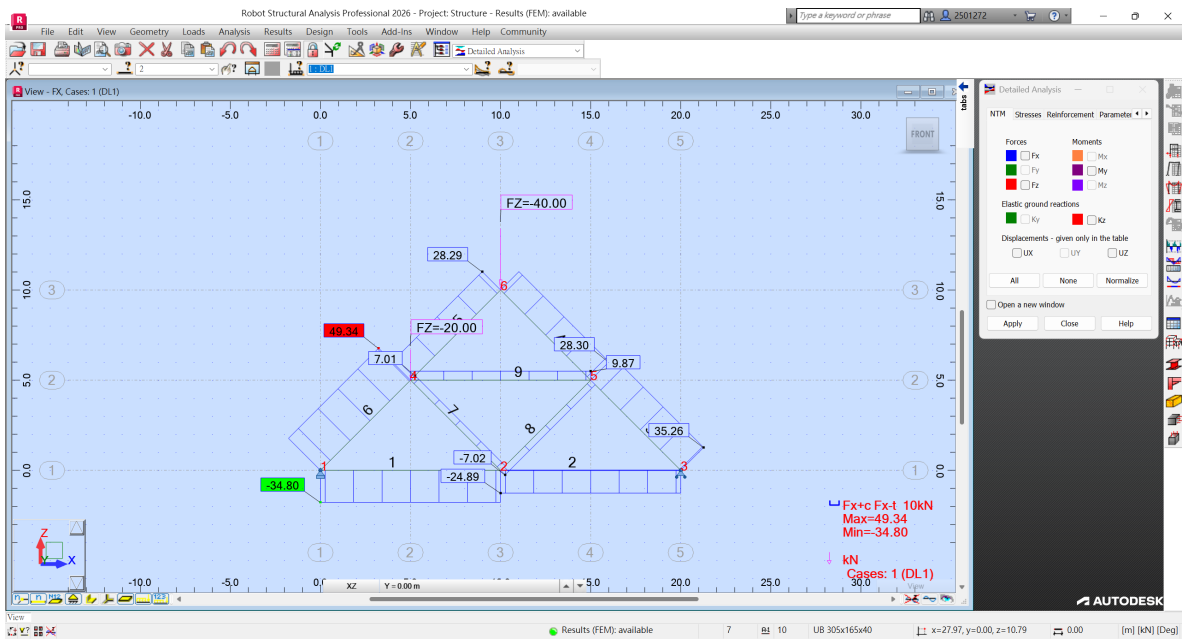


1 (a)

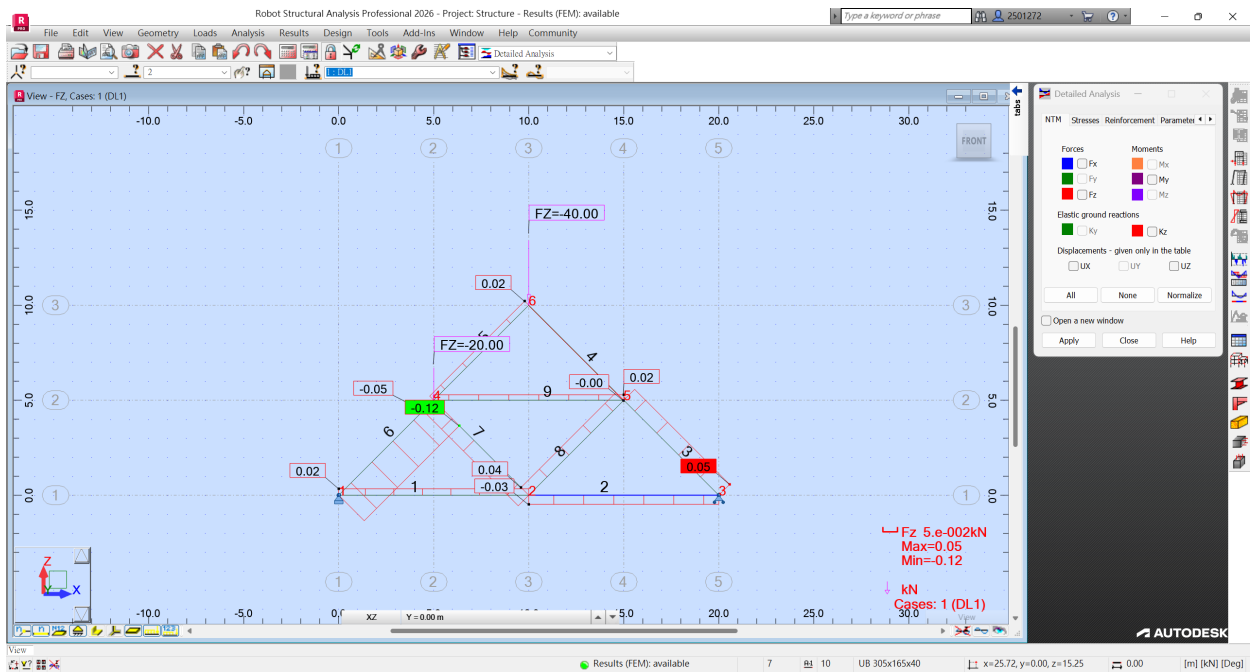
drawing



x-axis force



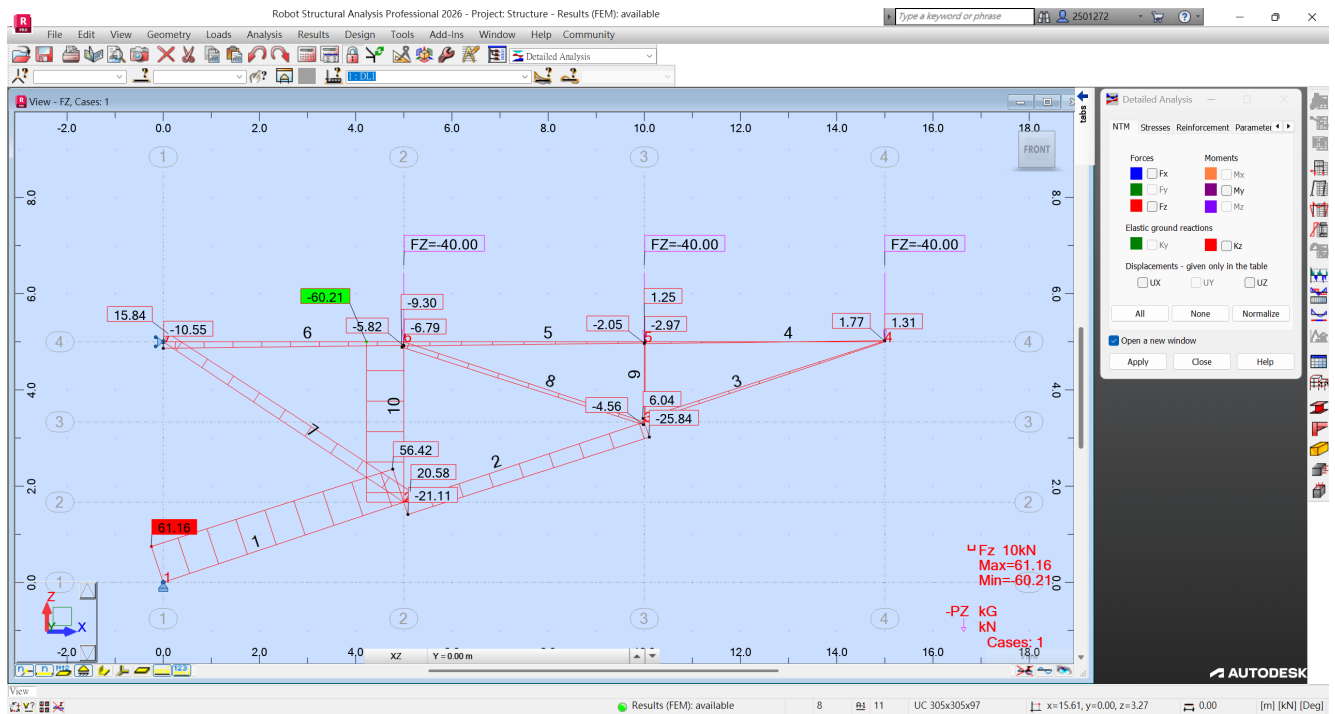
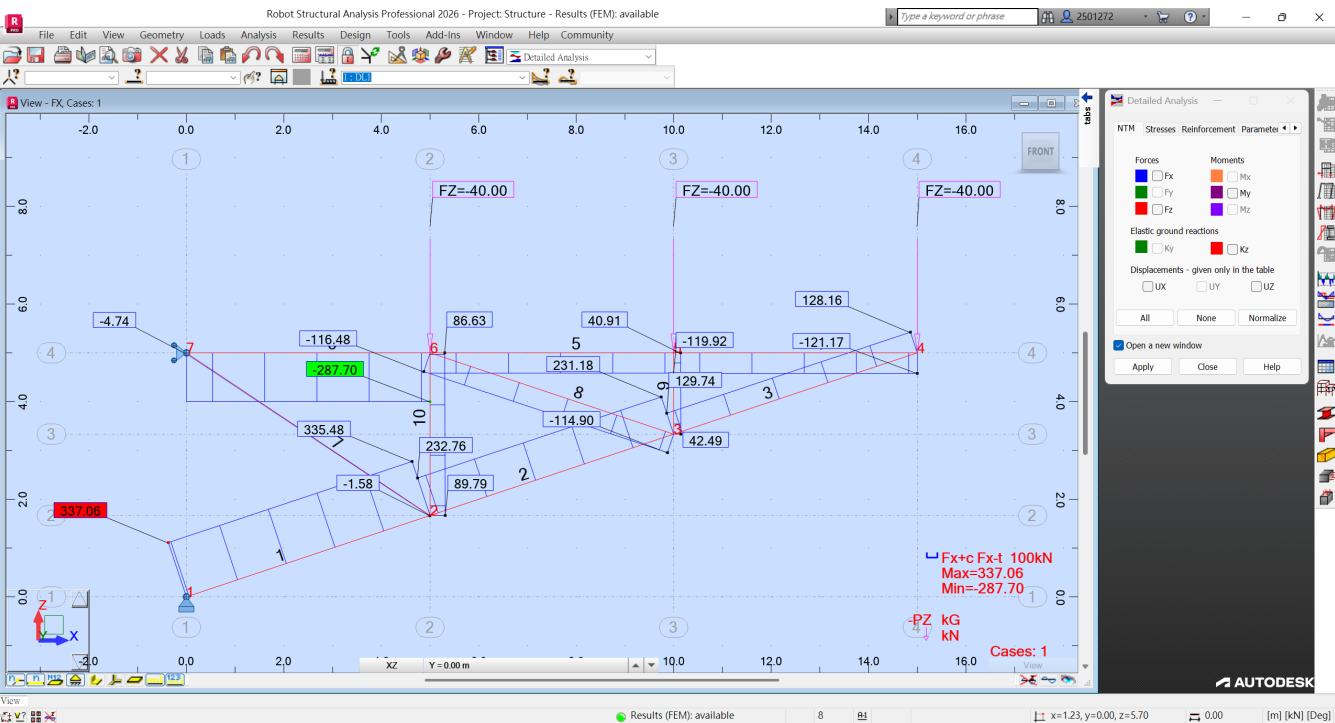
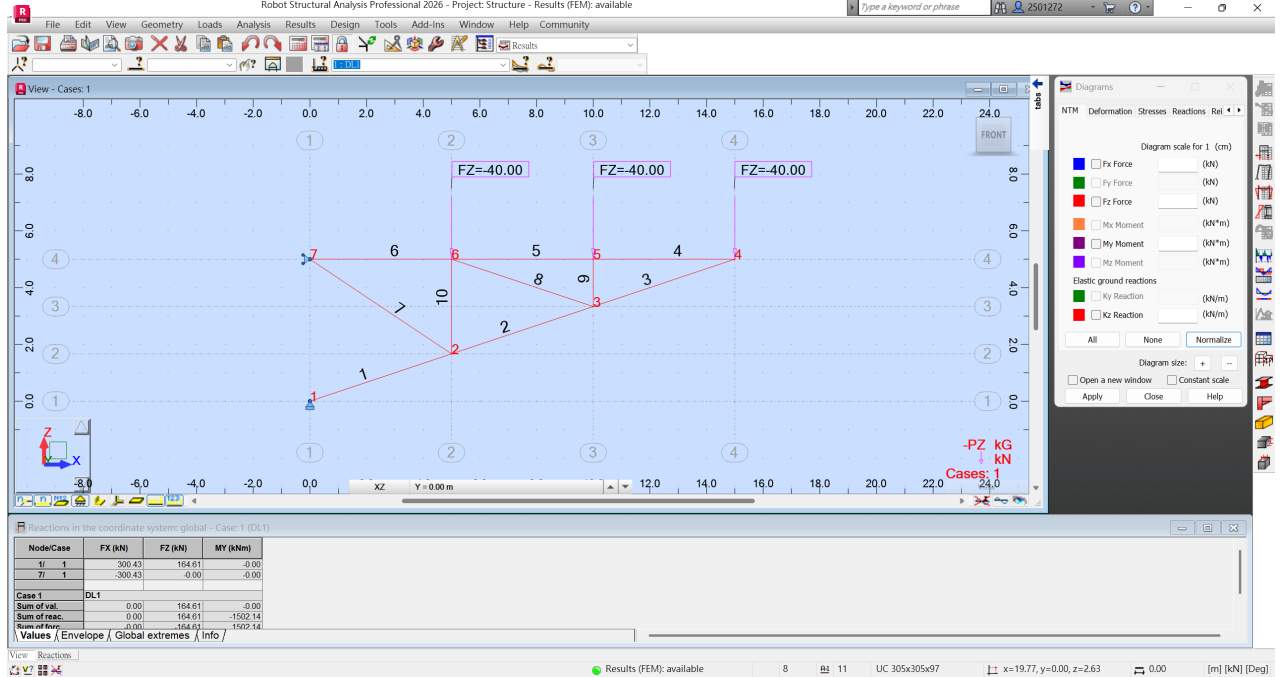
y-axis force



1(b)
drawing

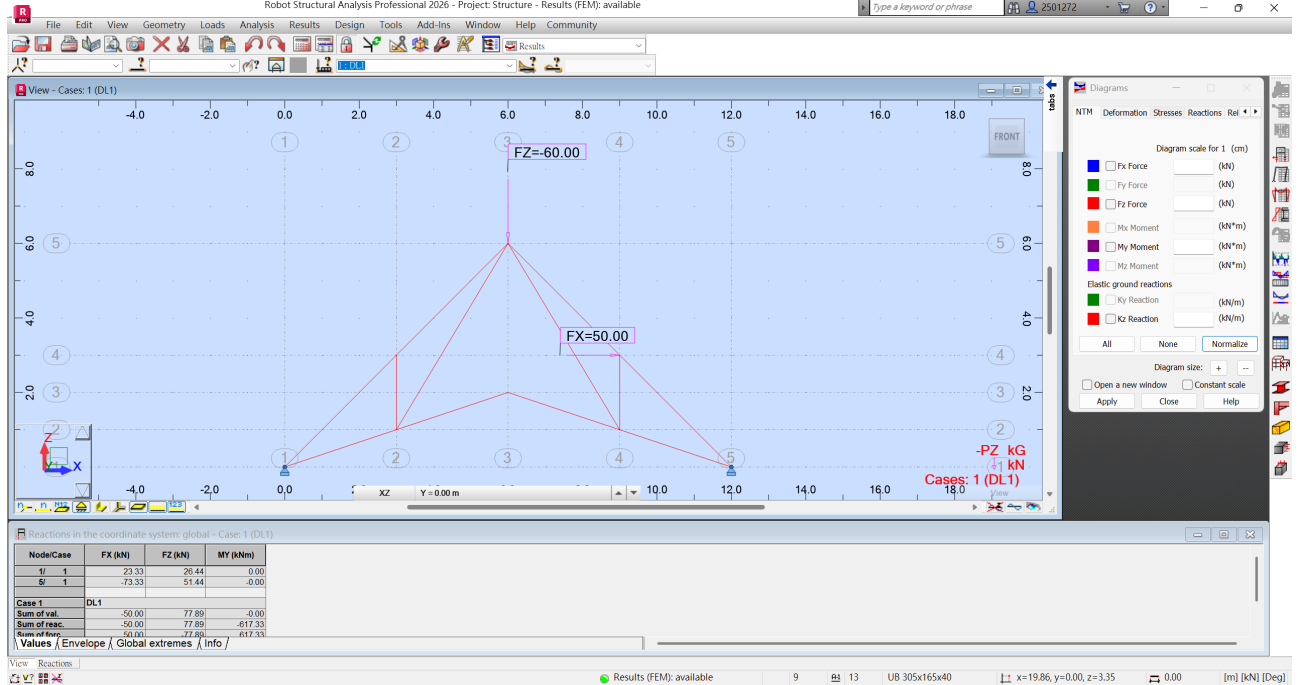
x-axis
force

y-axis
force

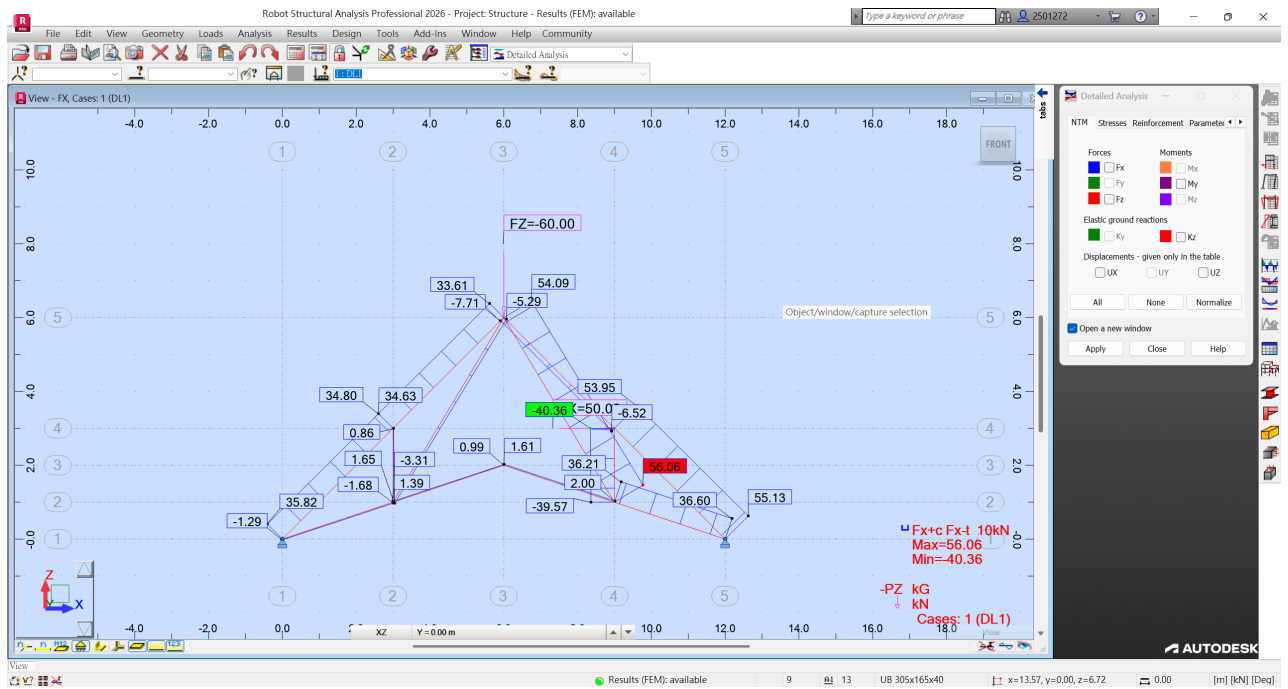


2(a)

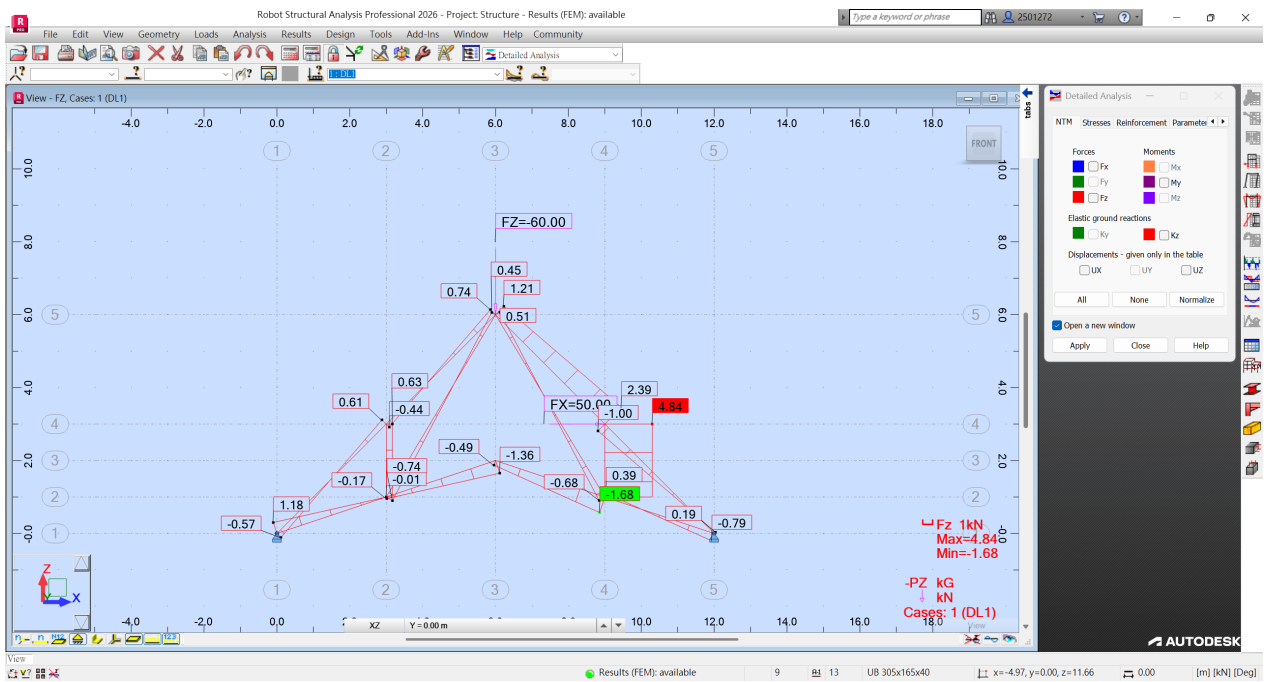
drawing



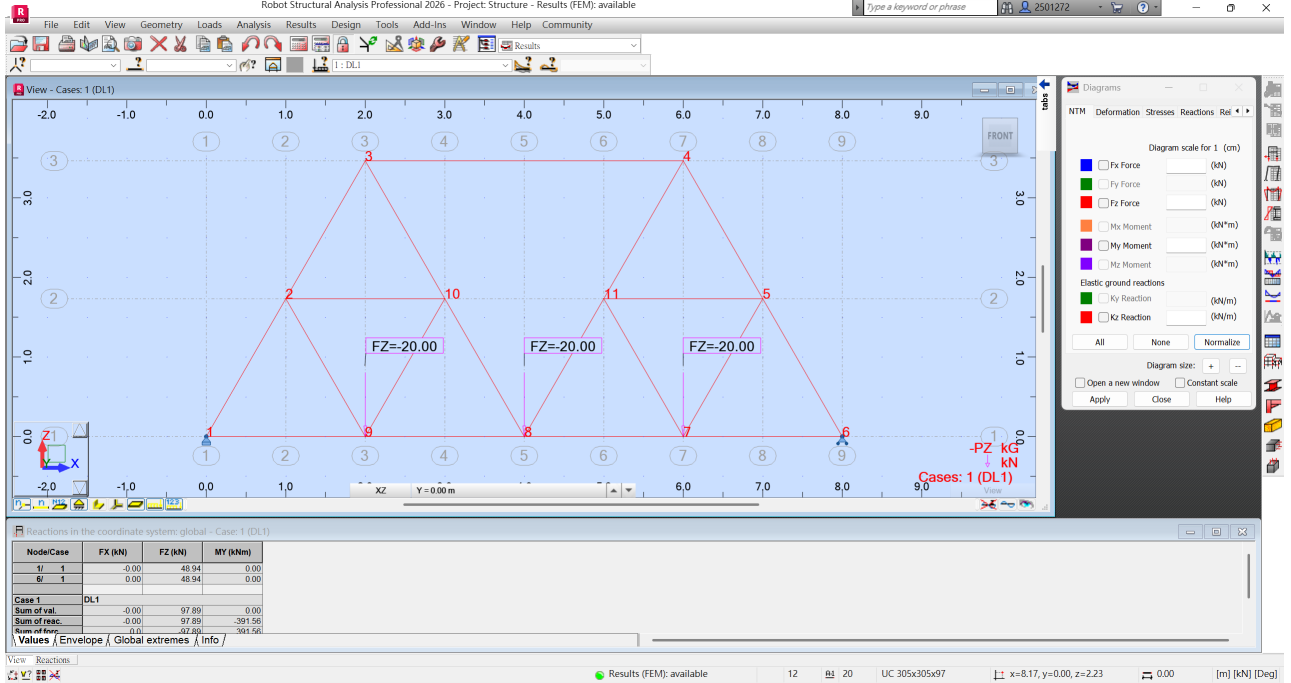
x-axis
force



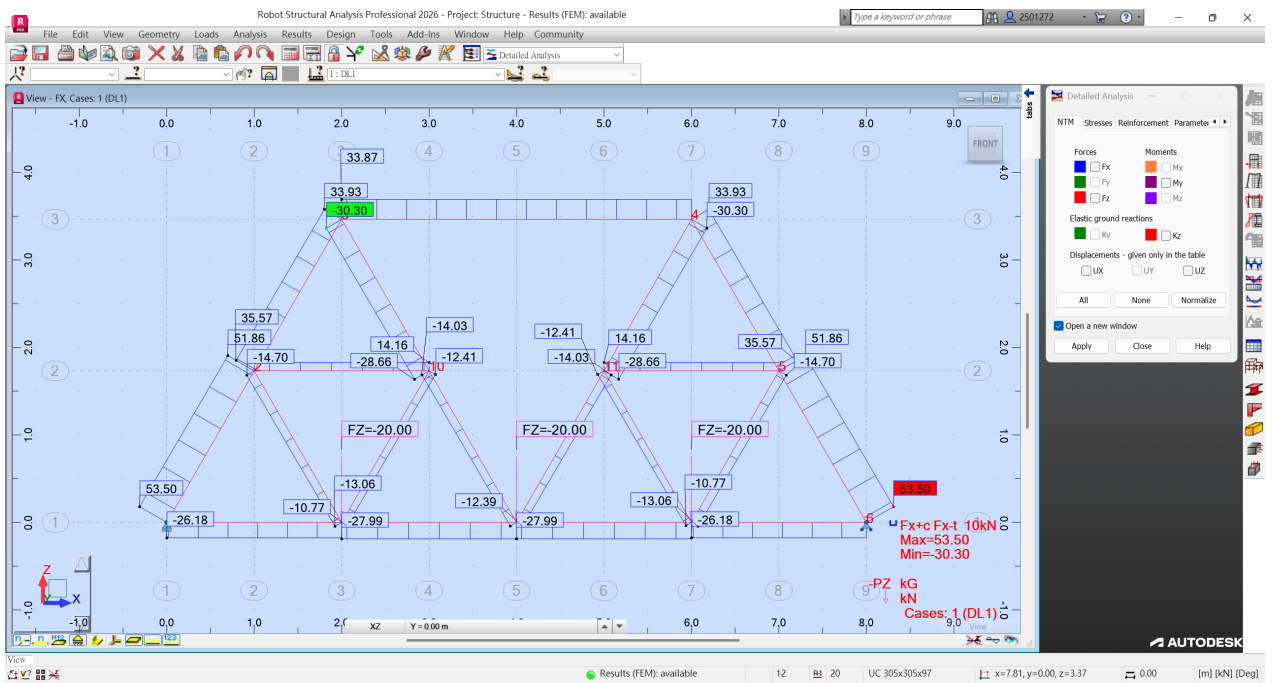
y-axis
force



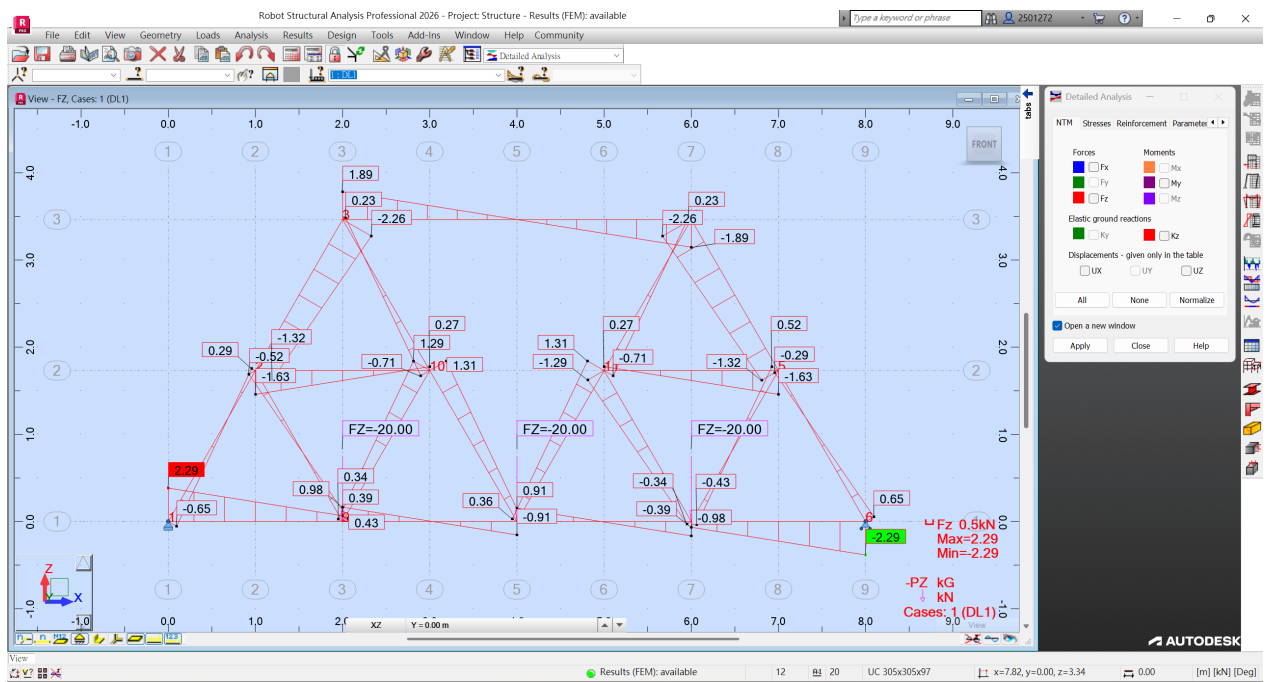
2(b)
drawing



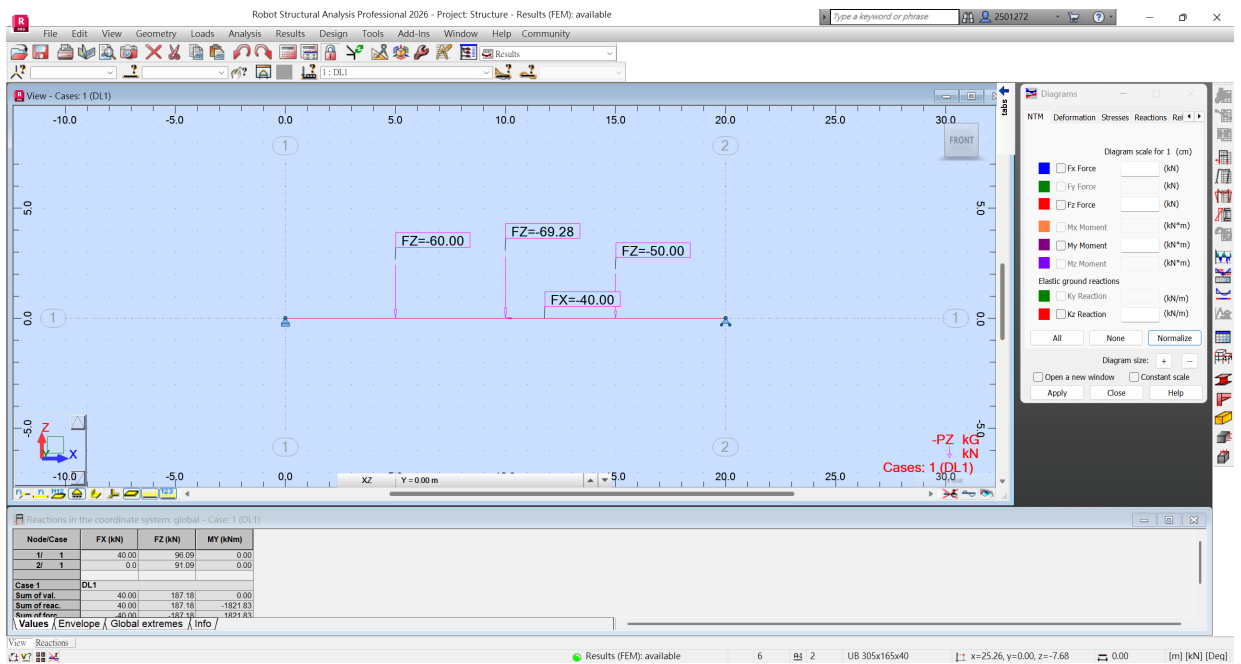
x-axis
force



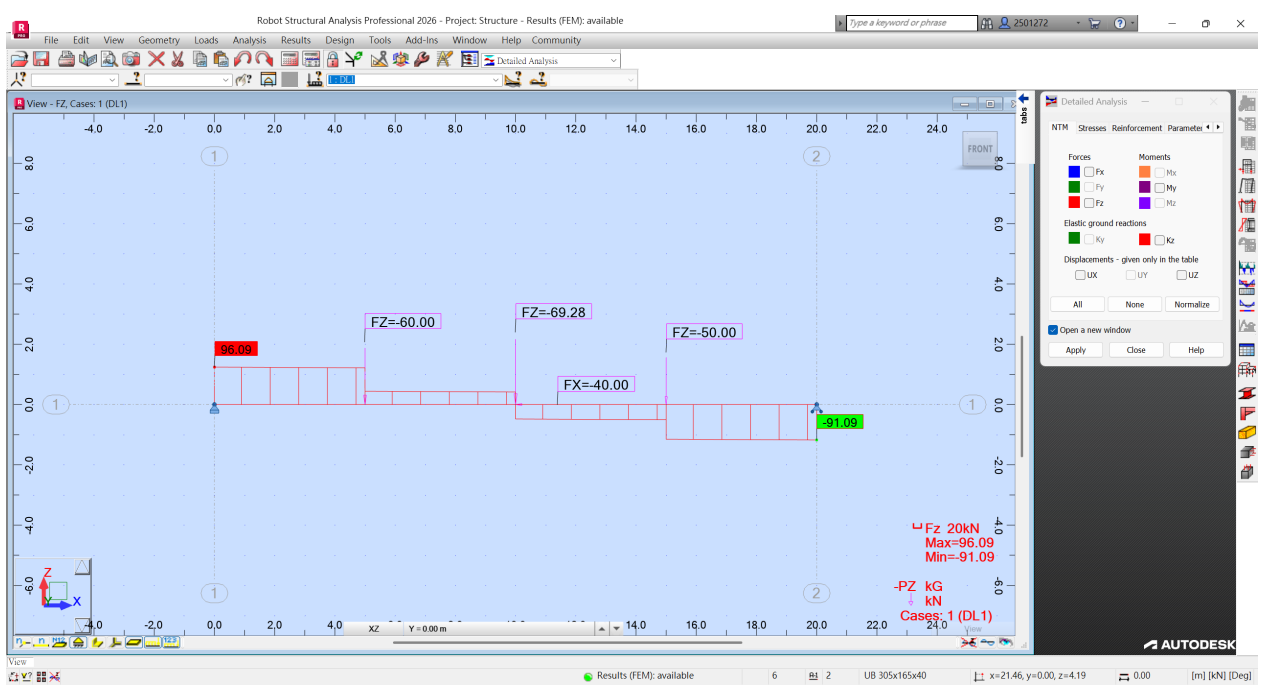
y-axis
force



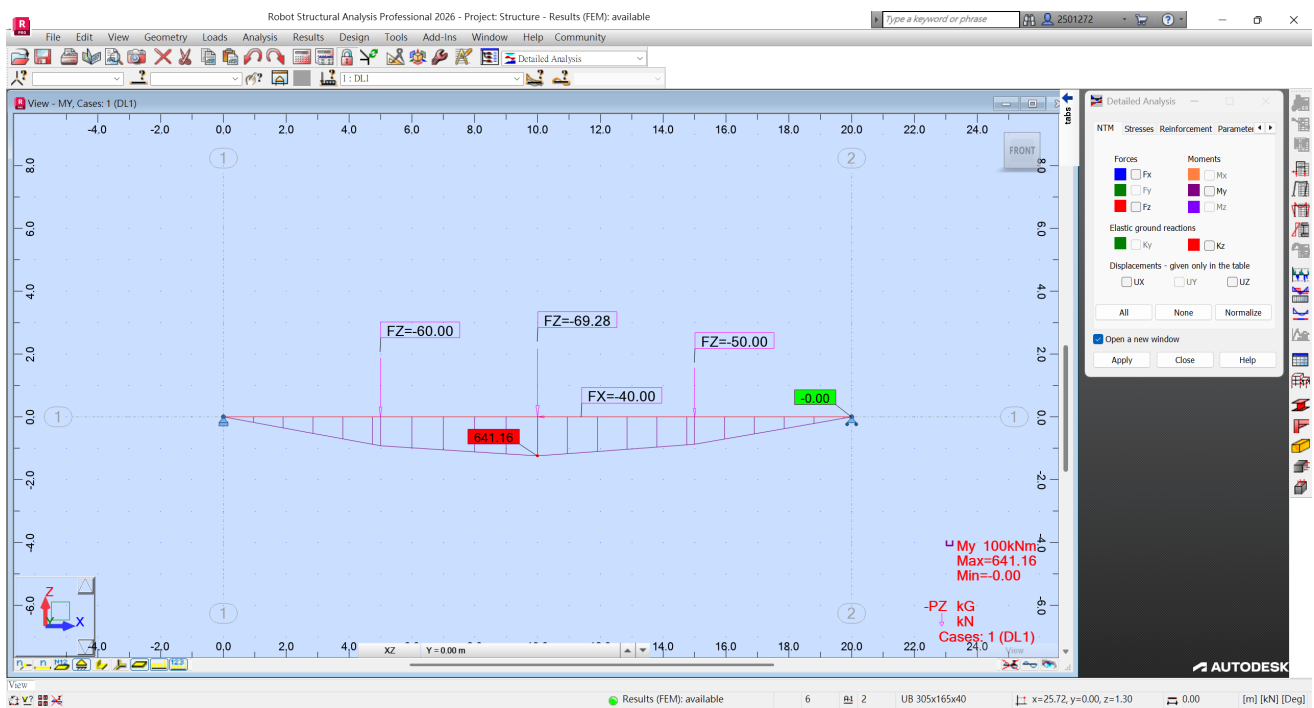
3(a)
drawing



Shear force
diagram

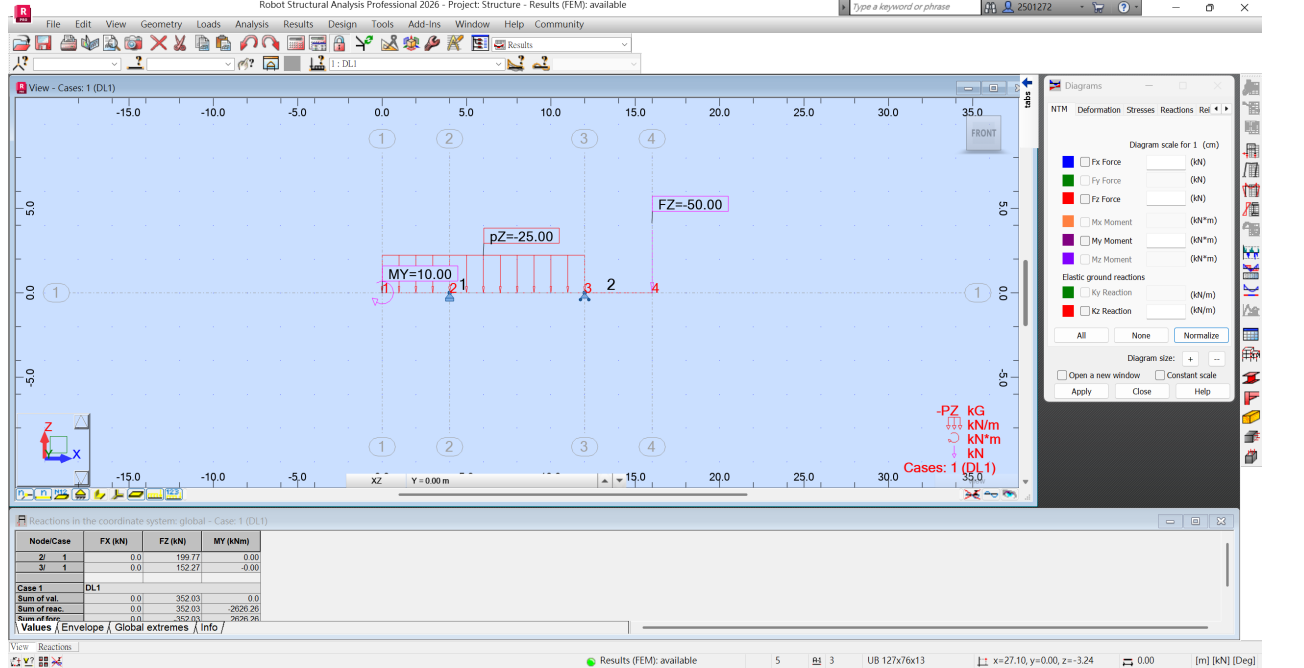


Bending
Moment
diagram

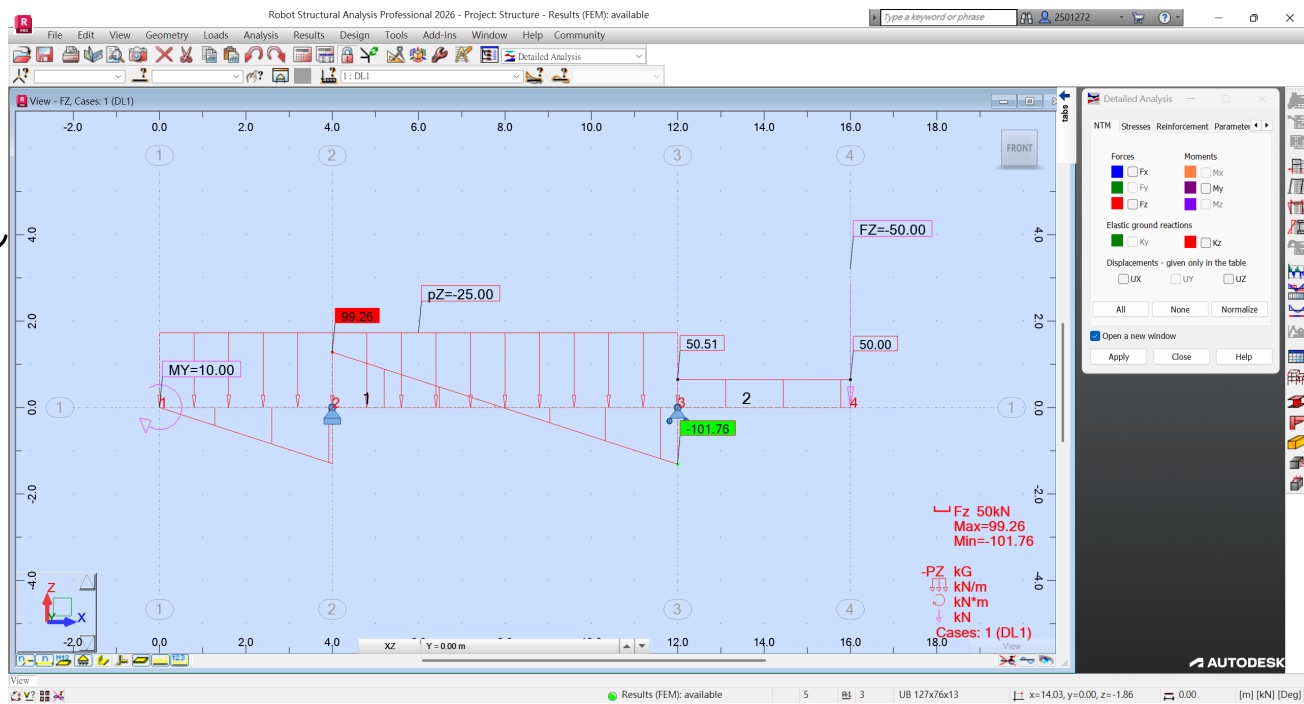


3(b)

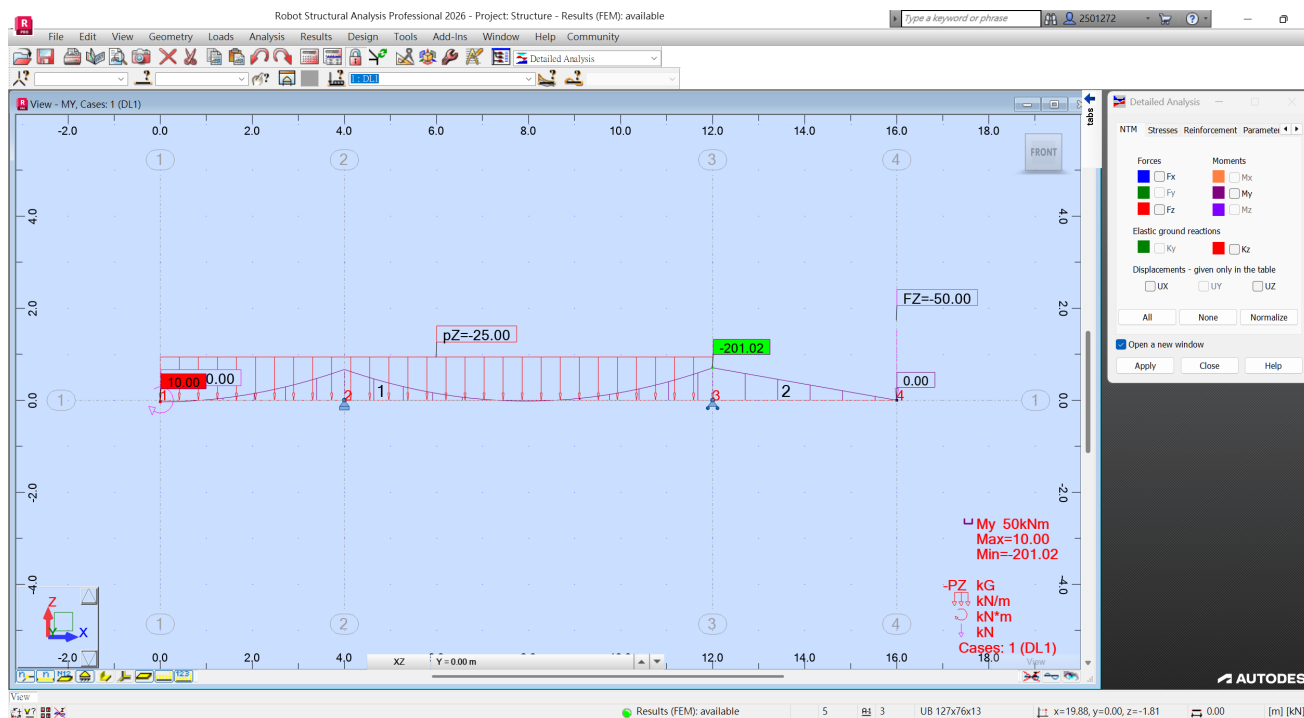
drawing



Shear force diagram



Bending Moment diagram



Overall, the hand calculations and the Robot Structural Analysis results agree closely in magnitude, with only minor discrepancies that can be attributed to the software's rounding and the limited number of decimal places displayed in the output. The bending moment diagram produced by Robot appears mirrored relative to the hand-drawn diagram because the software uses the opposite sign convention. Robot plots sagging moments on one side of the beam axis while my hand calculation took hogging as positive. Once the sign convention is reconciled, the two diagrams represent identical internal force distributions.