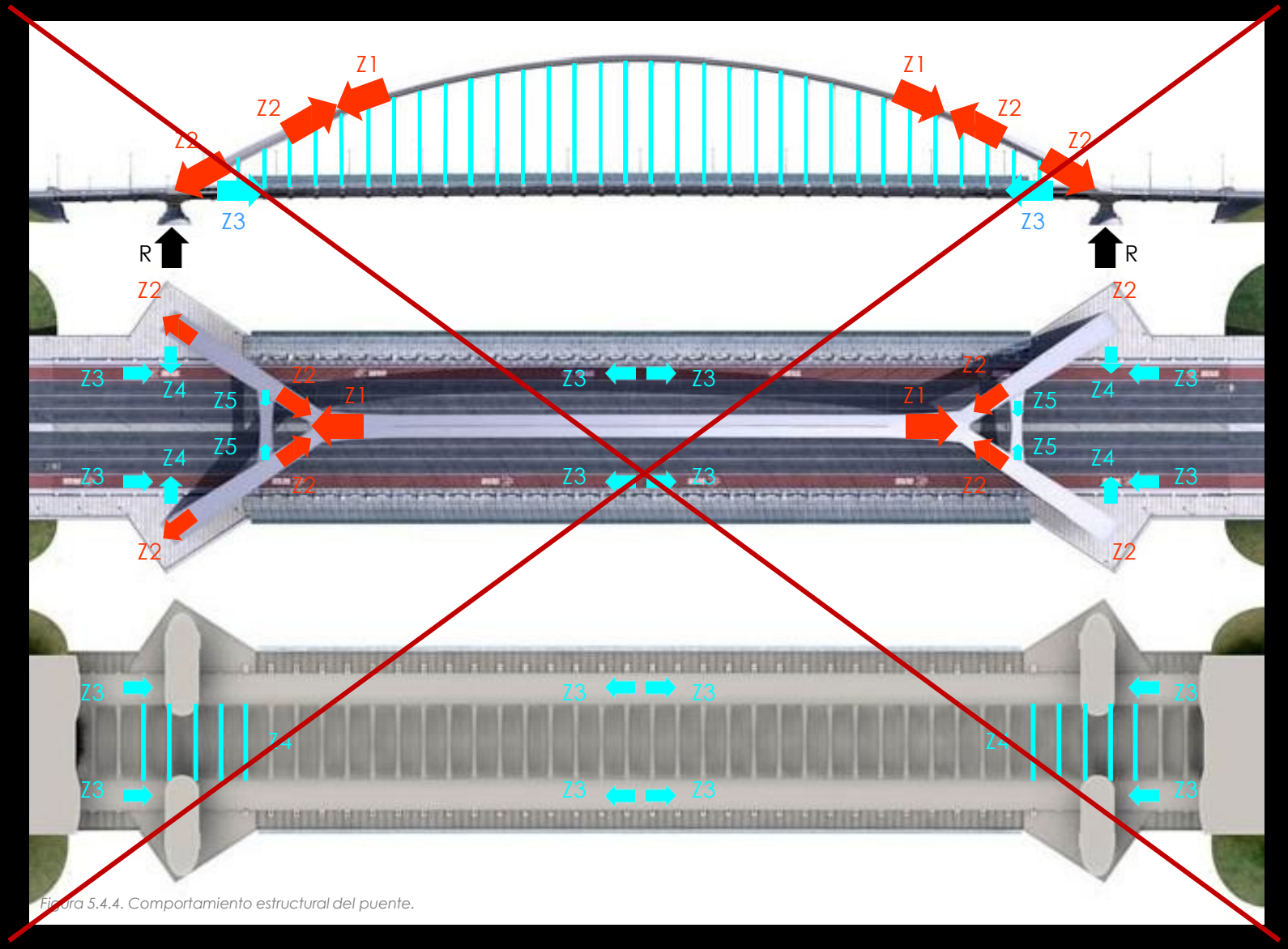
2 In plane loading – walls and beams

2.2 Stress fields with prestressing

Exercise solution

Exercise - Solution



Arrows without clear indication of the free body they act on can be confusing.

(this is not a good example of “explaining the force flow”)

→ always indicate the system (free body) the forces act on

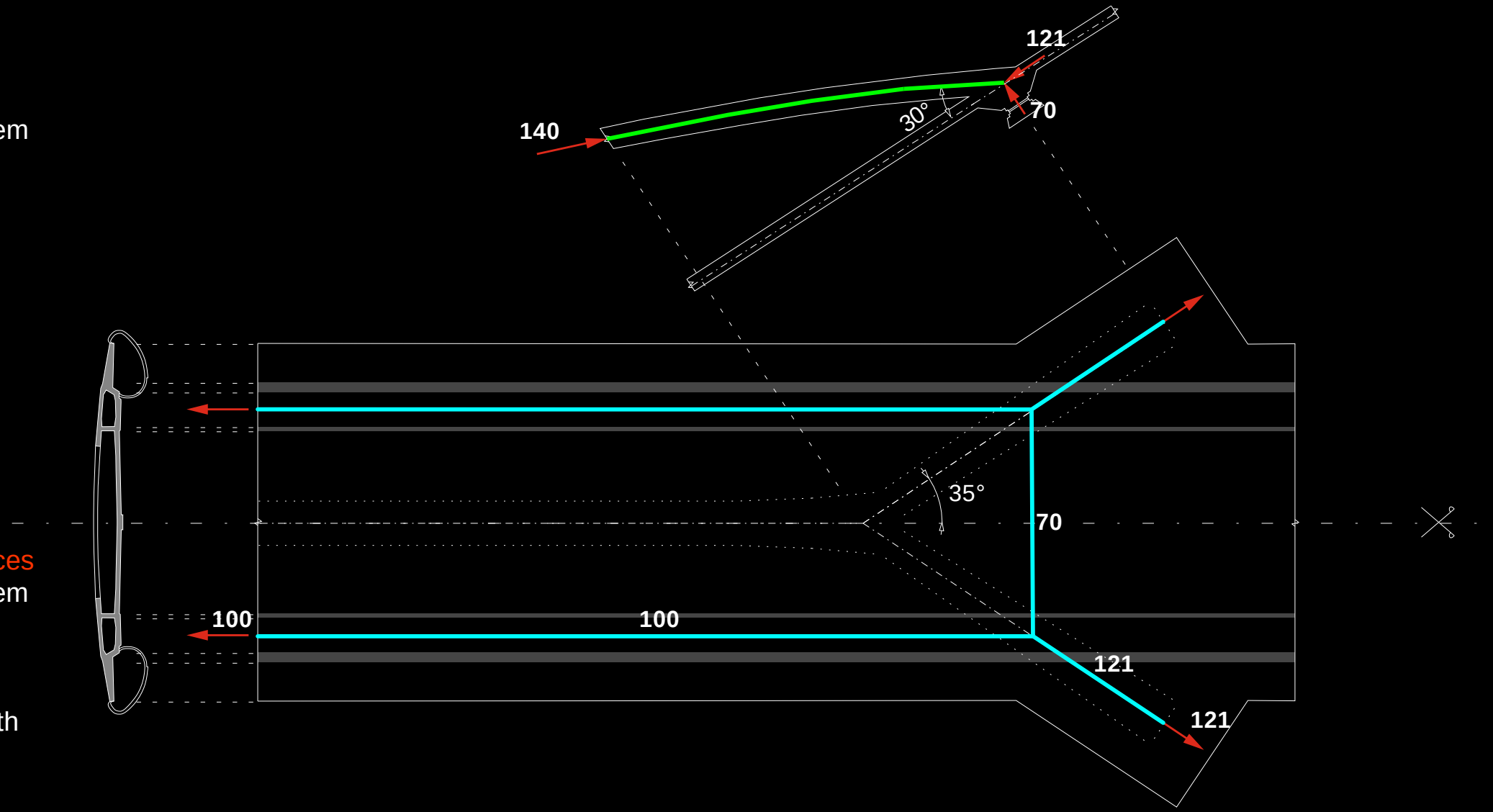
→ for example, isolating a node with all forces acting on it

Exercise - Solution

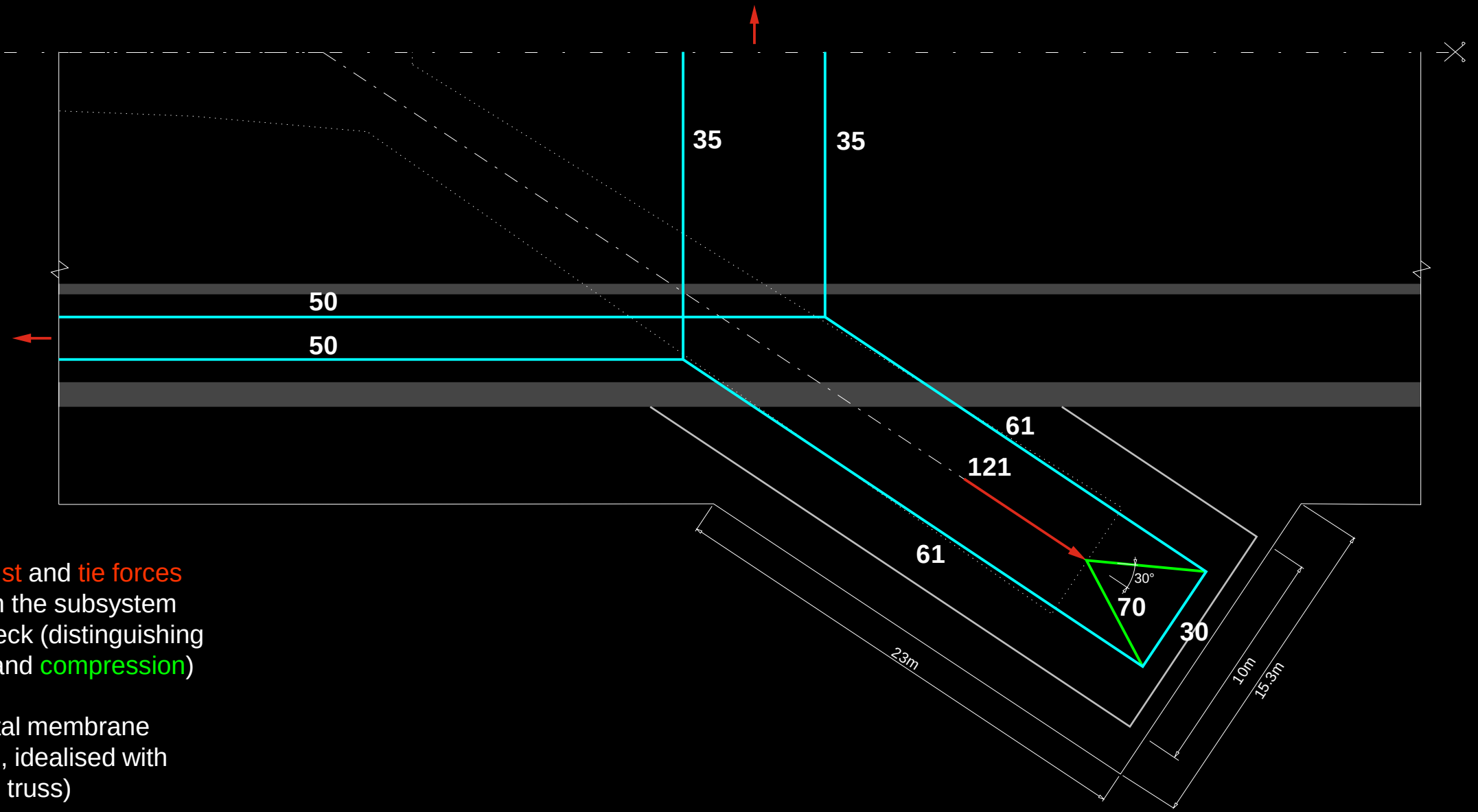
arch compression
acting on the subsystem
arch

arch thrust and tie forces
acting on the subsystem
bridge deck

(horizontal membrane
structure, idealised with
a simple truss)



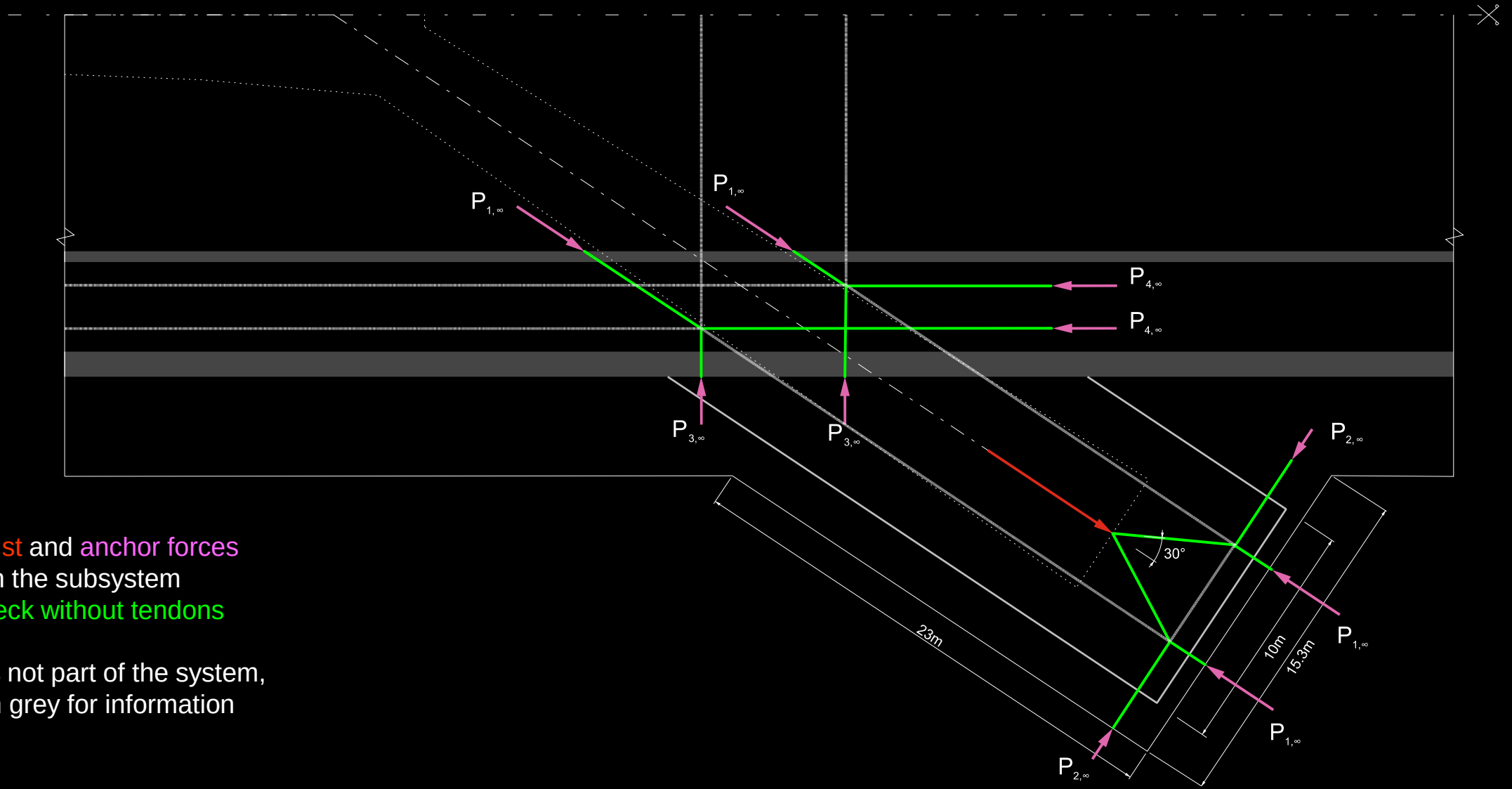
Exercise - Solution



arch thrust and tie forces acting on the subsystem bridge deck (distinguishing tension and compression)

(horizontal membrane structure, idealised with a refined truss)

Exercise - Solution



arch thrust and anchor forces acting on the subsystem bridge deck without tendons

(tendons not part of the system, shown in grey for information only)

Exercise - Solution

$$2 \cdot P_{1,\infty} = 0.7 \cdot 0.85 \cdot f_{pk} \cdot A_p \geq F_{1,d} = 121\text{MN}$$

$$A_{p,erf} = 109334\,\text{mm}^2$$

Choice: 40x19 ∅0.6" $\left(A_{p,i} = 150\,\text{mm}^2\right)$

$$A_p = 114000\,\text{mm}^2$$

$$2 \cdot P_{1,\infty} = 126.2\,\text{MN} > F_{1,d} \qquad \text{ok}$$

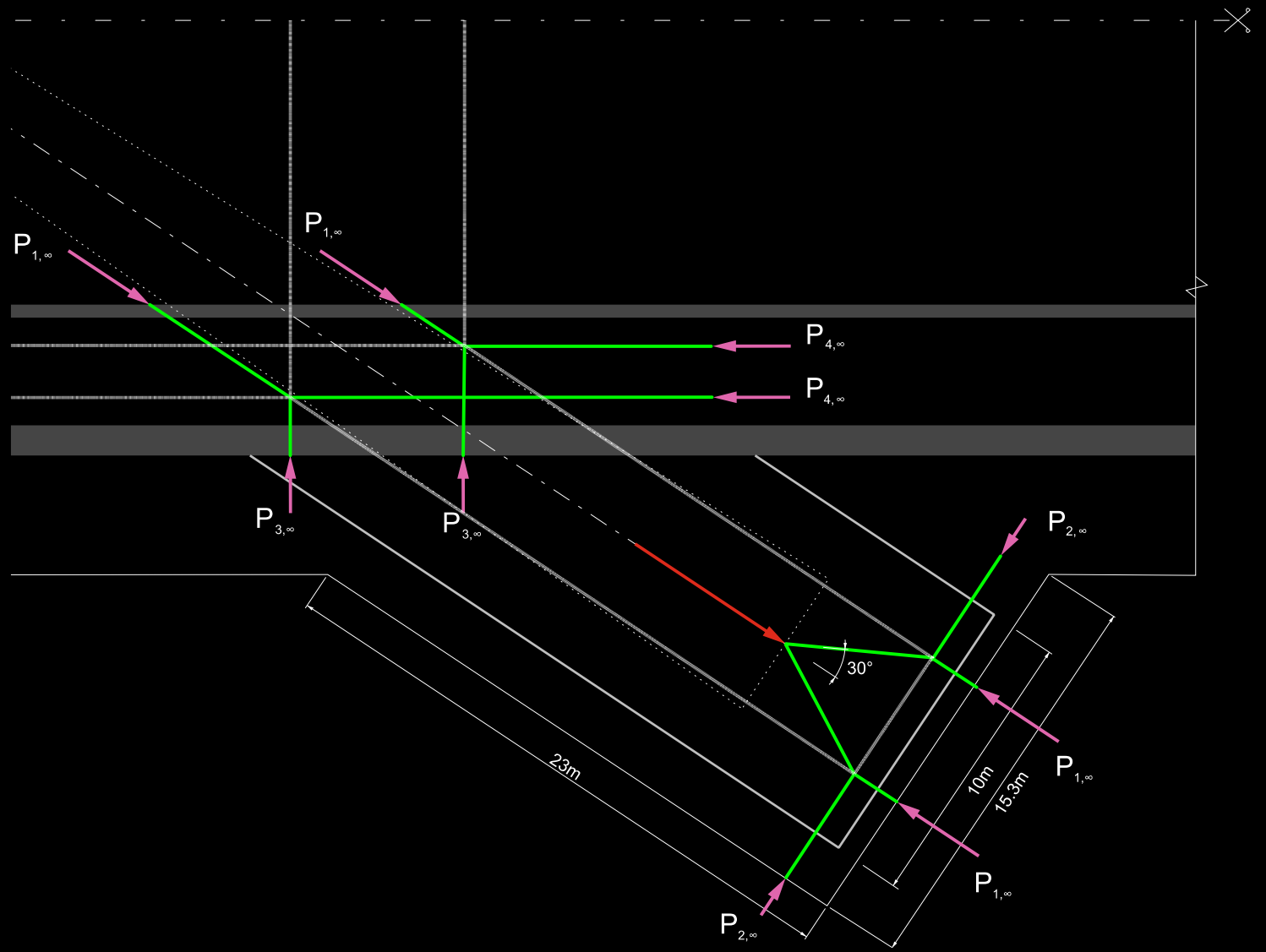
$$2 \cdot P_{1,0} = 148.4\,\text{MN}$$

$$\sigma_{c,p,0} = \frac{2 \cdot P_{1,0}}{10\,\text{m} \cdot 0.8\,\text{m}} = 18.6\ \text{MPa} < 0.8 \cdot f_{cd} \qquad \text{ok}$$

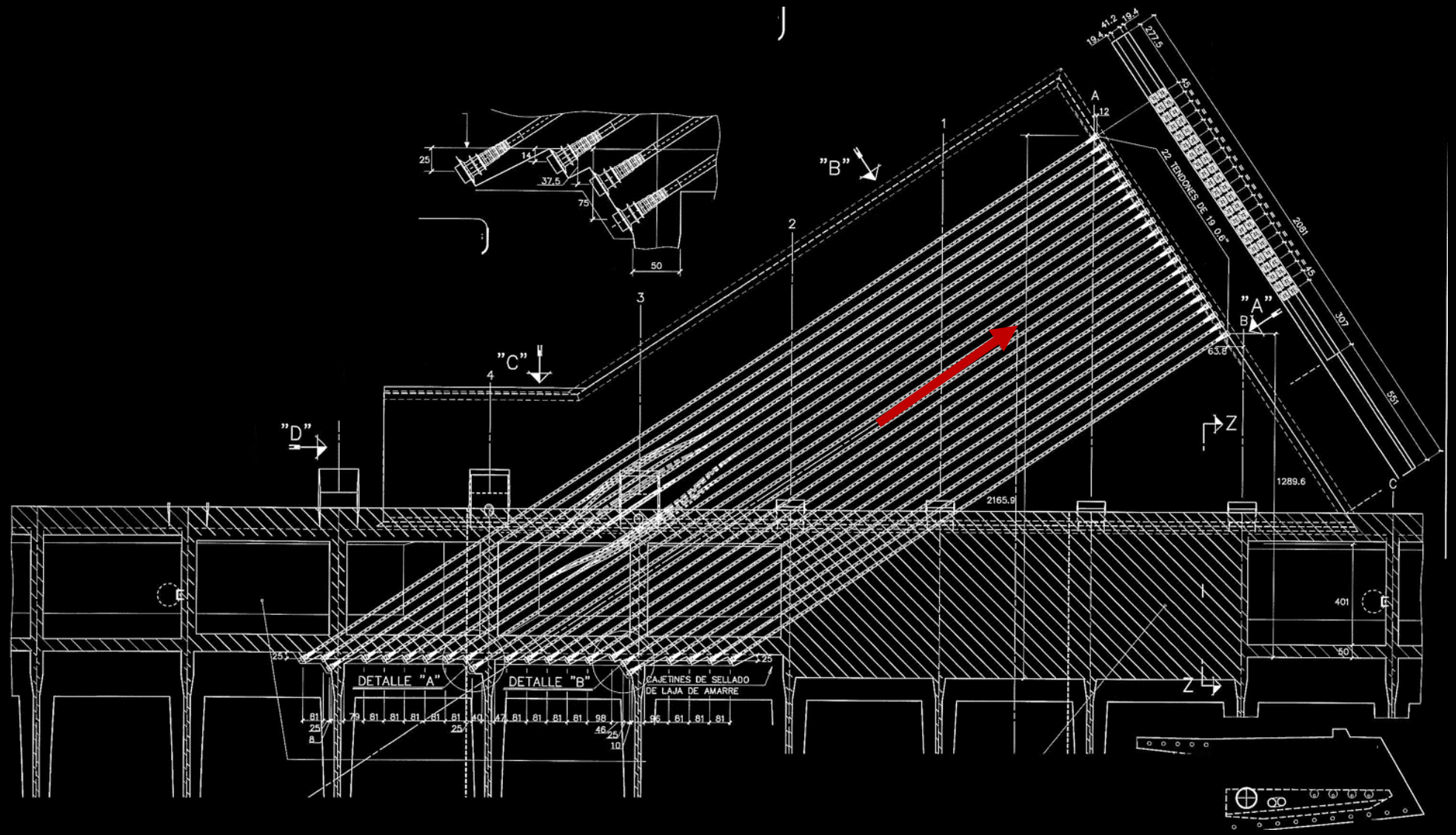
$P_{2,\infty}$: Choice: 10x19 ∅0.6"

$2 \cdot P_{3,\infty}$: Choice: 22x19 ∅0.6"

$2 \cdot P_{4,\infty}$: Choice: 31x19 ∅0.6"



Exercise - Solution



Exercise - Solution