Assignment CIE4150

Check the ultimate limit state for one or the following designs. Use plastic or elastic analysis to determine the force flow. Present the calculation on …….. Prepare the presentation carefully according to the requirements below. You are either in the elastic team or the plastic team. The team objective is to give very fast presentations. Members of the winning team will receive each 1 point extra for exam CIE4150. Members of the other team will receive each 0.5 point extra.

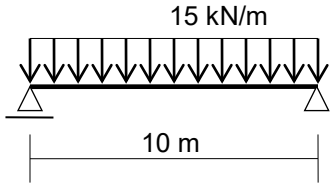
Background
A regularly occurring discussion amongst students, teachers and practitioners is about using elastic analysis or plastic analysis. Issues as accuracy, safety and economy are studied in the lectures. In addition, the time that is needed for the calculations is important. This is addressed in this analysis competition.

Procedure
In turn an elastic team member and a plastic team member will present his or her calculation. The teacher will measure the time needed. The opposing team can make objections if one of the requirements below is violated. In that case, the teacher will stop the clock. The teacher can determine penalty seconds. The team that needs the least total time has won.

Requirements for the presentation
1) Write clearly on the blackboard or on the flip over.
2) All steps performed need to be explained clearly.
4) It is only allowed to use memorised formulas if these are for often occurring situations.
5) You can use tables and codes of practice.
6) You can use a laptop computer.
7) Computer modelling and computer calculations need to be done on the spot.
8) Applied mechanics shall be used correctly.
9) Calculation errors are not allowed.
10) End your presentation with the conclusion “The design is OK” or “The design is not OK”.

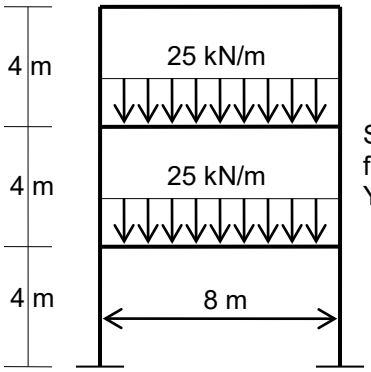
All numbers are design values. In other words, partial safety factors are already included. The dimensions are such that the serviceability conditions are fulfilled. Buckling does not need to be checked. Self-weight is included in the loading.

1



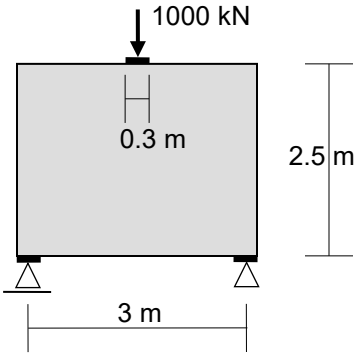
Section IPE 300
Yield stress = 330 N/mm²

2



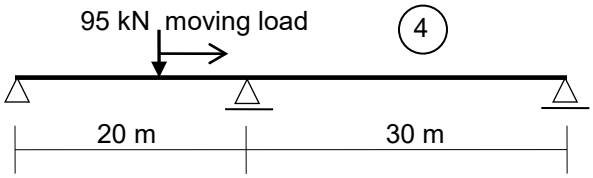
Section IPE 240
for all members
Yield stress = 300 N/mm²

3

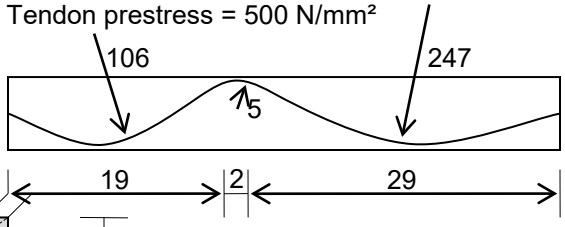


Wall thickness 100 mm
Main reinforcement 2∅16 mm horizontal at the bottom
Distributed reinforcement ∅10 – 180 mm hor. and vert. at both faces.
Yield stress = 350 N/mm²

4



Prestressed concrete beam
Beam width 250 mm, Depth 800 mm
Tendon cross-section area 1018 mm²
Yield stress = 700 N/mm²
Compressive strength = 50 N/mm²
Tendon prestress = 500 N/mm²



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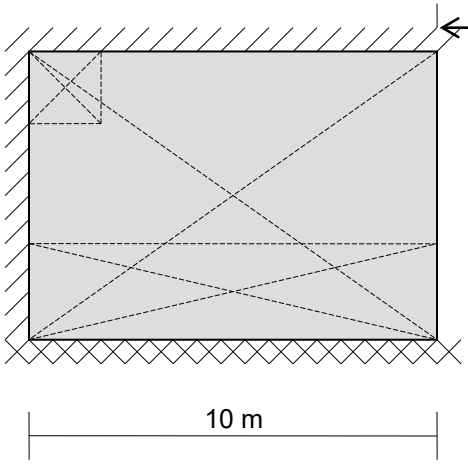
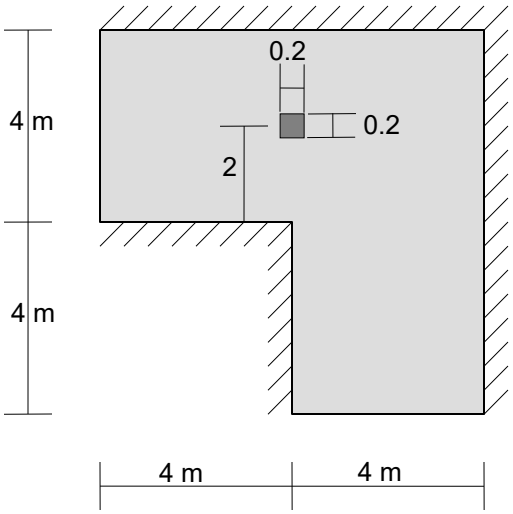


Reinforcement ∅16 – 150 in both directions at the bottom face and near the clamped edge in the top face
Yield stress = 320 N/mm²
Compressive strength = 35 N/mm²

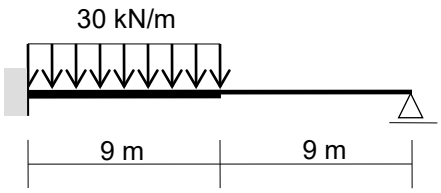
Reinforced concrete plate
Thickness 0.2 m
Evenly distributed load 8 kN/m²

6



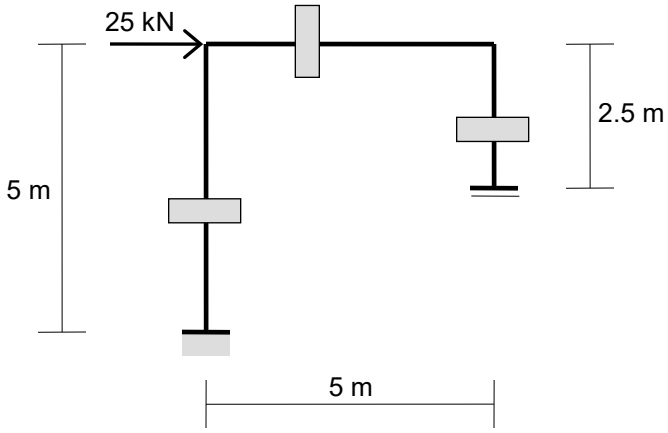
Reinforced concrete plate
Thickness 0.18 m
Evenly distributed load 5 kN/m²
Point load 150 kN over 0.2 x 0.2 m
Reinforcement ∅12 – 150 in both directions everywhere at the bottom face
No reinforcement in the top face
Yield stress = 320 N/mm²
Compressive strength = 30 N/mm²

7



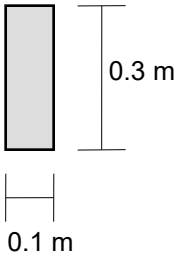
Section IPE 600
Section IPE 300
Yield stress = 330 N/mm²

8



Timber frame
Yield stress = 30 N/mm²

Glulam section



The moment capacity of the joints is the same as the moment capacity of the members.

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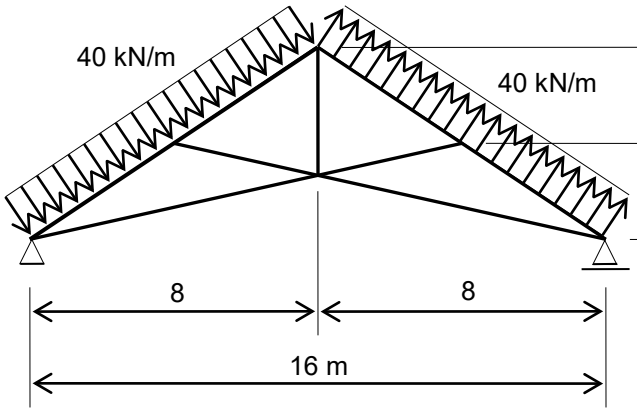
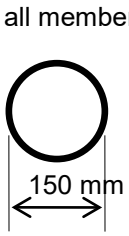
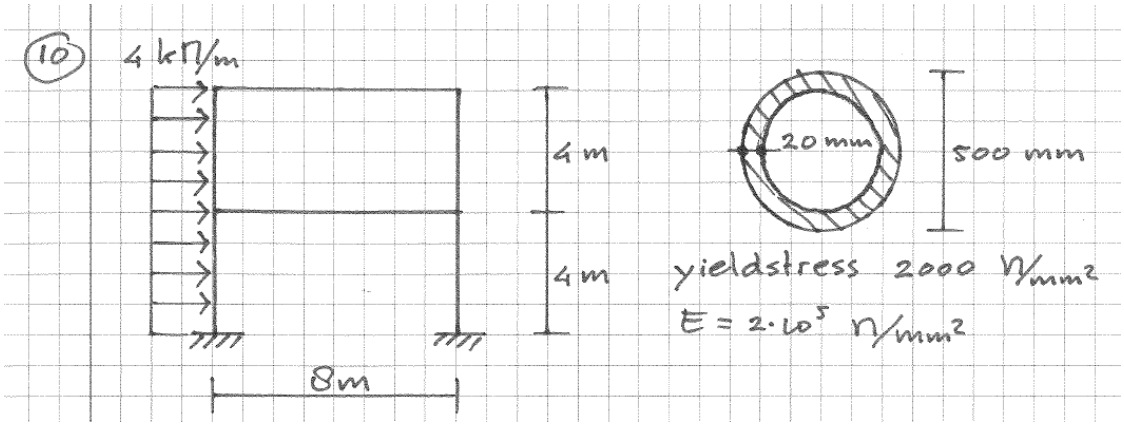




thickness 4 mm
yield strength 450 N/mm²
all joints fixed

10



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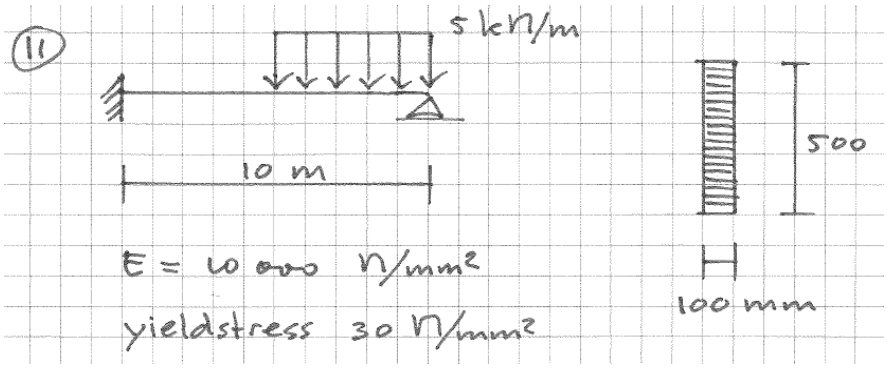

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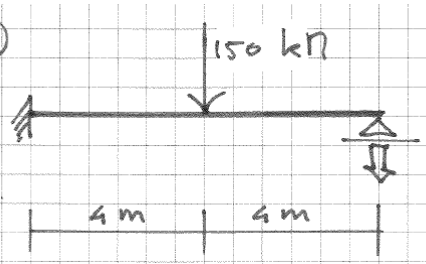
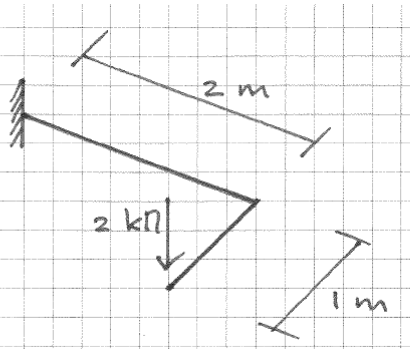
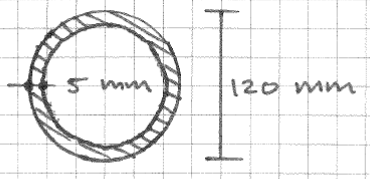


imposed displacement
50 mm

HE 140 B
yieldstress 350 N/mm²
E = 2·10⁵ N/mm²

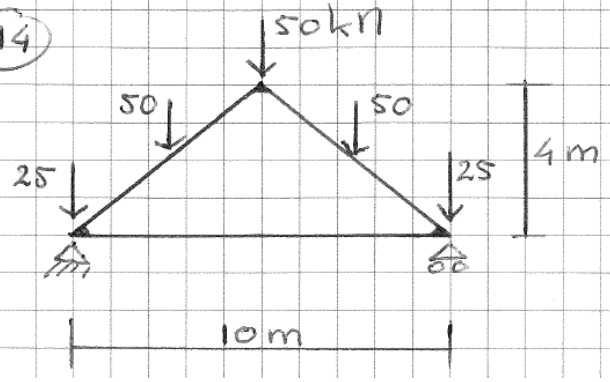
13

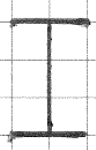




E = 30000 N/mm²
yieldstress 120 N/mm²

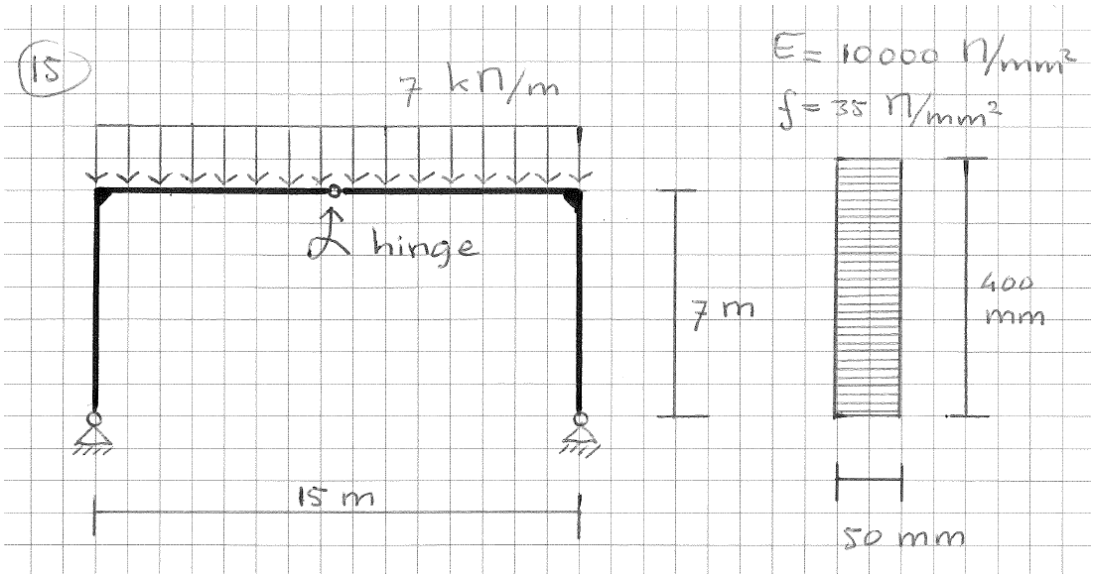
14



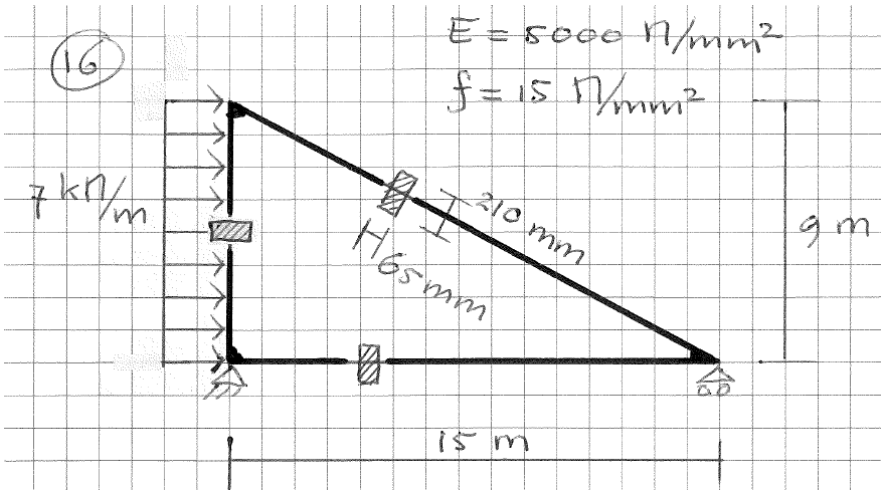


IPE 200
f = 350 N/mm²
E = 2,1 10⁵ N/mm²

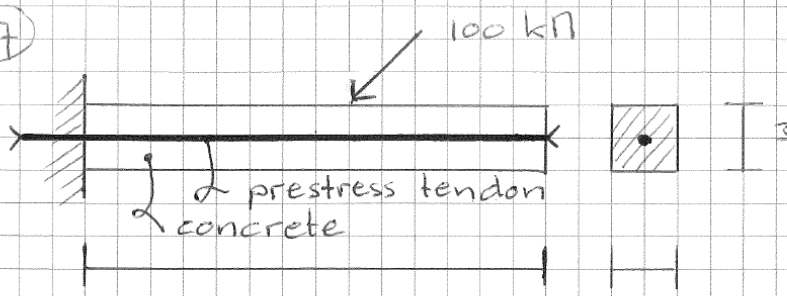
15


7 kN/m
hinge
7 m
15 m
E = 10000 N/mm²
f = 35 N/mm²
400 mm
50 mm

16


E = 5000 N/mm²
f = 15 N/mm²
7 kN/m
I 210 mm
H 65 mm
9 m
15 m

17



$A_s = \frac{1}{4}\pi 30^2 = 706\ mm^2$

$f_s = 900\ N/mm^2$

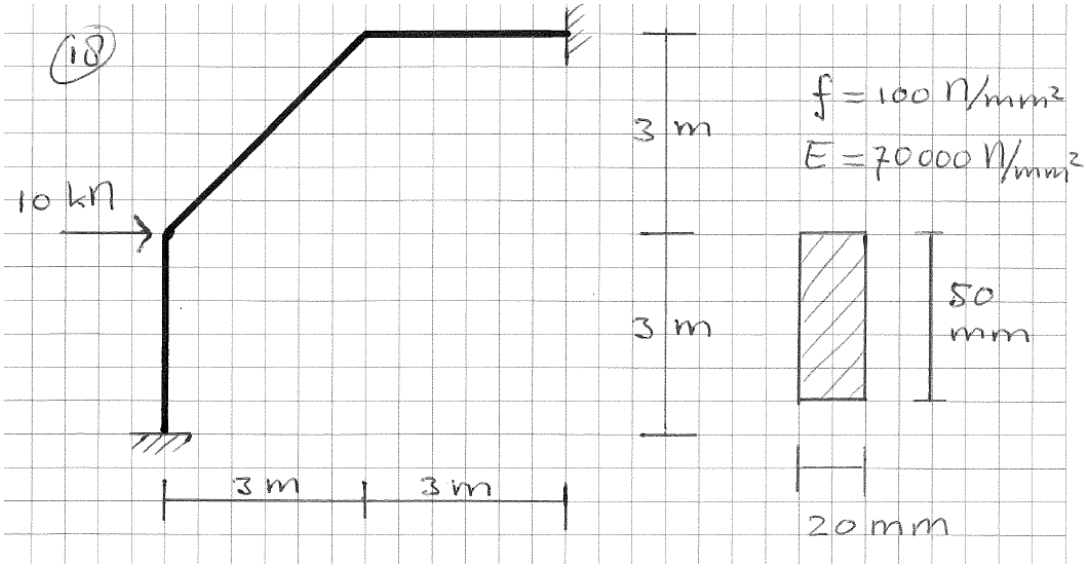
$F_p = 280\ kN$

$E_s = 2.1\ 10^5\ N/mm^2$

$E_c = 0.3\ 10^5\ N/mm^2$

$f_c = 40\ N/mm^2$

18



19