higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T150(E)(N13)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL CONSTRUCTION N5

(8060015)

13 November 2013 (X-Paper)
09:00–13:00

Candidates will require drawing paper.

Drawing instruments may be used.

This question paper consists of 8 pages, 1 formula sheet and SABS 82 Shape Codes.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING AND STRUCTURAL CONSTRUCTION N5
TIME: 4 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Drawings must be done according to the latest building regulations.
5. Drawings must be fully dimensioned, labelled and steel coded where required.
6. Labelling must be done horizontally and in printing.
7. Use both sides of the drawing paper.
8. Write neatly and legibly.

QUESTION 1: BOLT CONNECTION

FIGURE 1 below, shows two tie bars connected by means of grade 4.6 bolts and two connector plates.

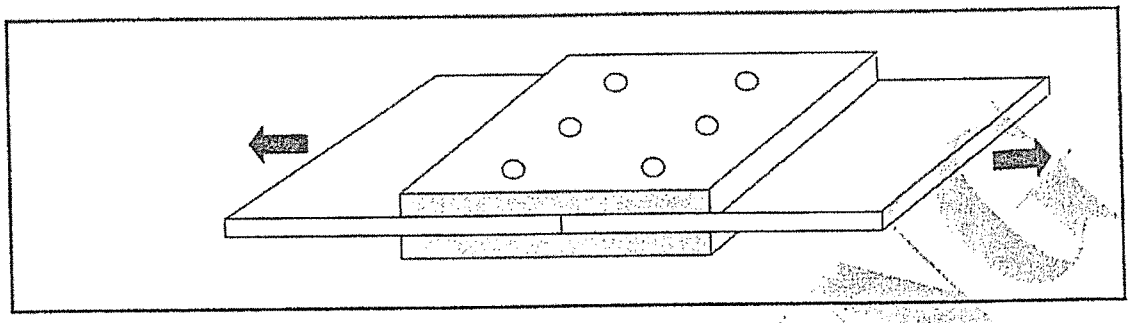


FIGURE 1

Calculate the following:

1.1 The tearing stress in the tie bars, if the 12 mm bolts go through 14 mm holes (Tie bars are 122 x 6 mm and force in tie bars is 350 kN) (3)

1.2 The diametre of the bolts, if the load is 85 kN and the shear stress is 100 MPa (4)

1.3 The maximum load that the bolts can safely withhold if the bolt size is 16 mm, and the maximum bearing stress is 250 MPa
(Tie bars are 122 x 6 mm and connector plates are 4 mm) (4)
[11]

QUESTION 2: FRAMEWORK

FIGURE 2 below, shows a loaded frame structure.

Draw this frame accurately to scale 2 cm = 1 m and determine the following: (3)

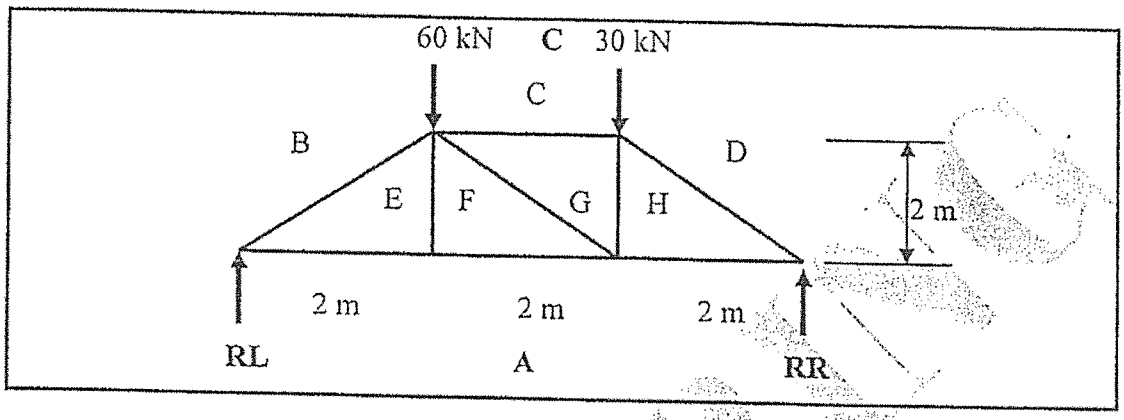


FIGURE 2

2.1 The forces of the reactions at RL and RR (4)

2.2 The size of the forces in each member and distinguish between *tension* and *compression stress* (13)

Tabulate the results as follows:

MEMBER	MAGNITUDE	TIE or STRUT
AE		
AF		
AH		
BE		
CG		
DH		
EF		
FG		
GH		

[20]

QUESTION 3: SECTION MODULUS

FIGURE 3 below, shows the profile of a cross section of a steel shaft. The dimensions are given in centimetres.

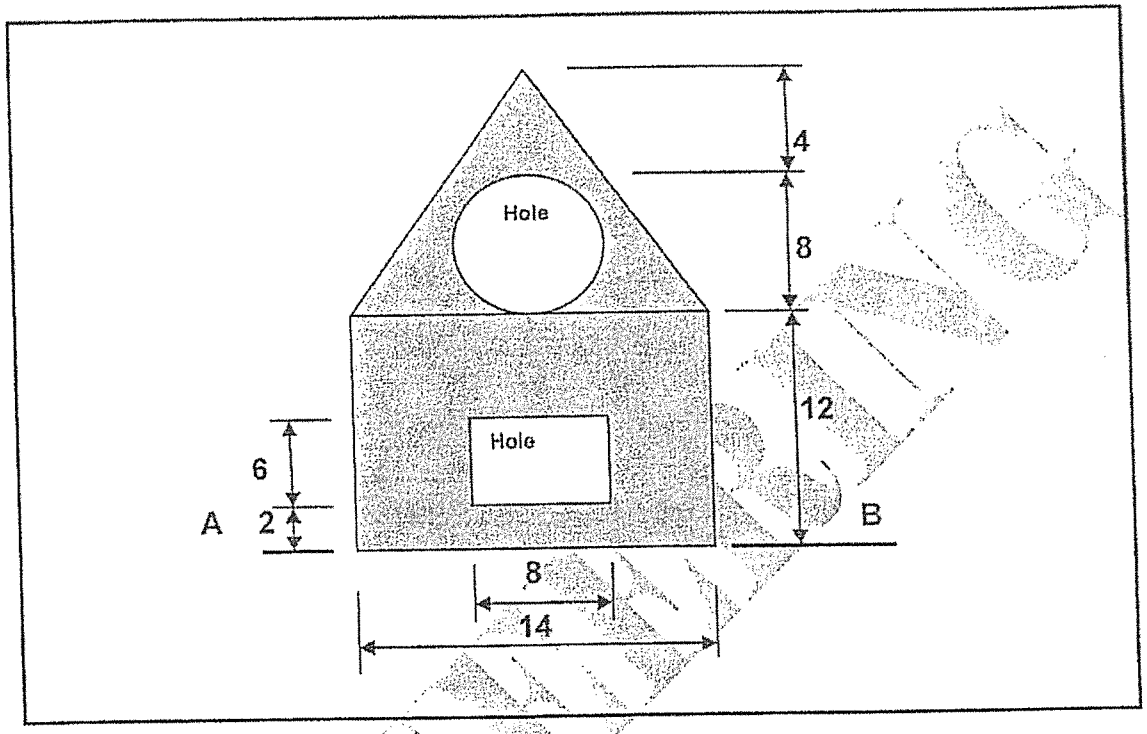


FIGURE 3

Calculate the following:

3.1 The position of the neutral axes (NA) from AB (2)

3.2 The moment of inertia of the profile about the neutral axis N-A (4)

3.3 The profile modulus (z) about the neutral axis (N-A) (2)

3.4 The maximum bending moment, if the allowable bending stress is 155 MPa (2)
[10]

QUESTION 4

FIGURE 4 below, shows a profile of a reinforced concrete stair case, which is one metre wide. Copy this profile, not to scale, in the ANSWER BOOK, (not on the drawing sheet).

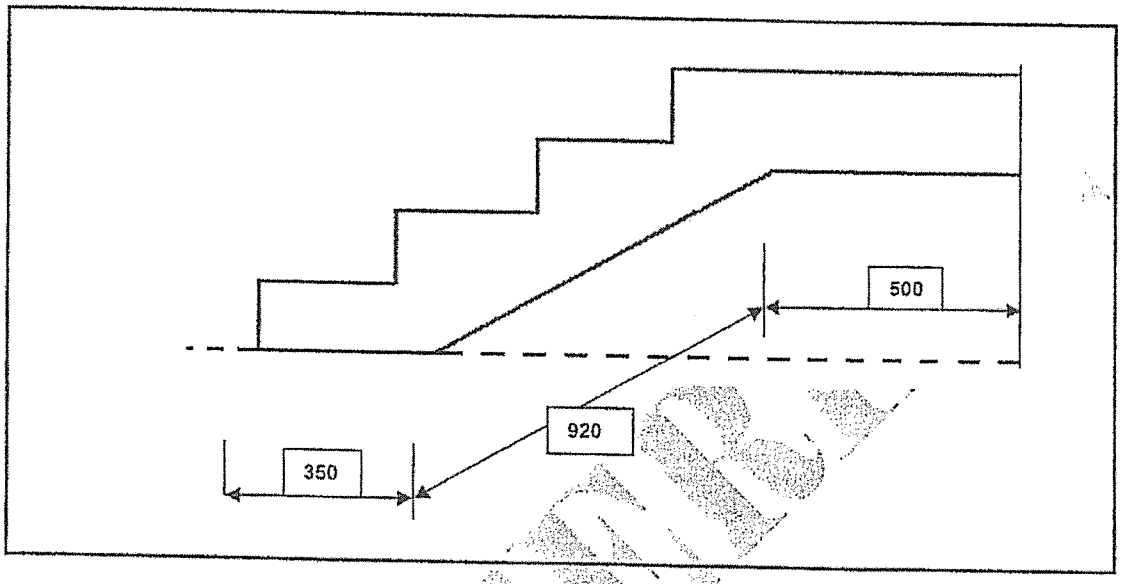


FIGURE 4

4.1 Add the following steel reinforcement with steel codes:

4.1.1 Main reinforcement, with steel code 6Y1601-200 and with shape code 41

4.1.2 Secondary reinforcement, with steel code 14Y1202-200 and with shape code 35

4.1.3 Compression reinforcement, with steel code 6R1003-200 and with shape code 41 (3)

4.2 Draw up a bending schedule for FIVE similar reinforced concrete staircases.

1	2	3	4	5	6	7	8
Member	Bar mark	Type and size	No of members	No in each	Total number	Length of each bar	Shape

(16)
[19]

QUESTION 5

A concrete slab is resting on a round concrete column. The column is 1 500 mm from the right-hand edge of the slab, which forms a balcony. A 220 mm face-brick wall is built at the edge of the cantilever slab, 15 mm from the edge to form a plinth.

Draw to scale 1 : 10 a vertical longitudinal cross section through part of the slab, the 1 500 mm long cantilever slab, the column and the double-face brick wall. Show at least 500 mm of the slab on the opposite side of the column and cantilever.

Use and include the following details and label the drawing correctly.

Concrete slab:	300 mm thick, with 6Y16, main reinforcement per metre and 6Y10 shear reinforcement per metre, and 6R12 compression reinforcement per metre, with 10 mm mild steel binders, at 200 mm centre distance. The first binder starts at the column.	(6)
Cantilever slab:	300 mm thick, with 6Y16, tension reinforcement per metre, 6Y16 shear reinforcing per metre and 6R10 compression reinforcement per metre with 10 mm binders at 150 mm centre distance	(6)
Column:	Diameter of 400 mm with 6Y16 mm longitudinal steel reinforcement and 8 mm round mild-steel helical binders at 200 mm centre distance Draw below the column a horizontal sectional view, to scale 1 : 5, of the column and label this view	(6)
Floor off-finishing:	300 x 300 mm ceramic tiles fixed with tile cement	(4)

Show at least 500 mm of the concrete column at the bottom of the slab.

[22]

QUESTION 6

An I-Section parallel flange steel stanchion with base plate is prepared for a steel structure. The stanchion and the base plate are strengthened by means of two flange plates which are welded to the flange of the stanchion and the base plate.

Draw to scale 1 : 5, an isometric view of the stanchion with the strengthening sections to show the construction details clearly.

Use the following specifications:

Base plate:	600 x 600 x 25 mm with Ø22 mm holes drilled 25 mm from the edges at the corners
Stanchion:	306 x 178 x 74,8 kg/m
Flange plates:	400 x 210 x 10 mm
Welding specifications:	The flange plates are fillet-welded all-around in the factory, but the base plate is welded all-around on the construction site

Show at least 350 mm of the stanchion above the gusset plates.

Label the drawing and insert the welding symbols. **[14]**

QUESTION 7

Explain the meaning of the steel shape in the SABS Shape Codes, of number 86, by answering the following questions:

7.1 What would be the name of the steel shape? (1)

7.2 What does the letter 'A' represent? (1)

7.3 What does the letter 'B' represent? (1)

7.4 What does letter 'C' represent? (1)
[4]

TOTAL: 100

FORMULA SHEET

Any applicable formula may also be used.

$BM = \frac{wl}{4}$

$BM = \frac{wl^2}{8}$

$n = 5d$
$n = 5.5d$

$h = 9d$
$h = 11d$

$F = f.a$

$F = \sigma_s \frac{\pi D^2 n}{4}$

$F = \sigma_t [(B \times t) - n(d \times t)]$

$F = \sigma_c D.t.n$

$F = \frac{\pi(\phi - 0{,}9382\rho)^2 n}{4}$

$I = \left[\frac{BD^3}{12}\right] + [2area.y^2]$

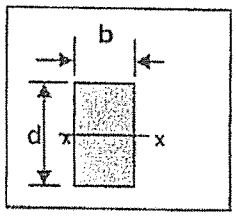
$\frac{M_r}{I} = \frac{f}{y} = \frac{E}{R}$

$M = fZ$

$Z = \frac{I_{NA}}{y}$

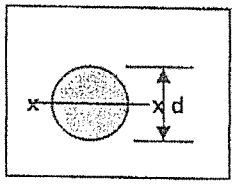
$M = f\frac{I}{y}$

$M = \frac{fbd^2}{6}$



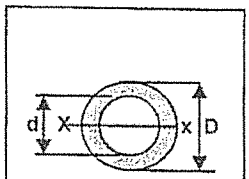
$I_{xx} = \frac{bd^3}{12}$

$Z_{xx} = \frac{bd^2}{6}$



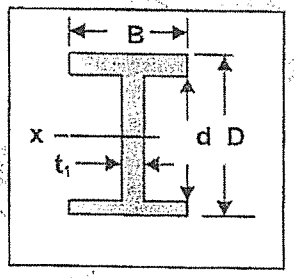
$I_{xx} = \frac{\pi.d^4}{64}$ or $I_{xx} = \frac{1}{4}\pi r^4$

$Z_{xx} = \frac{\pi.d^3}{32}$

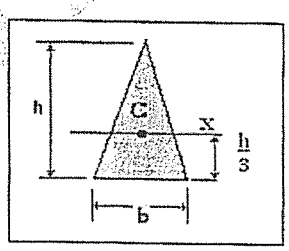


$I_{xx} = \frac{\pi}{64}(D^4 - d^4)$

$Z_{xx} = \frac{\frac{\pi}{64}(D^4 - d^4)}{D/2}$



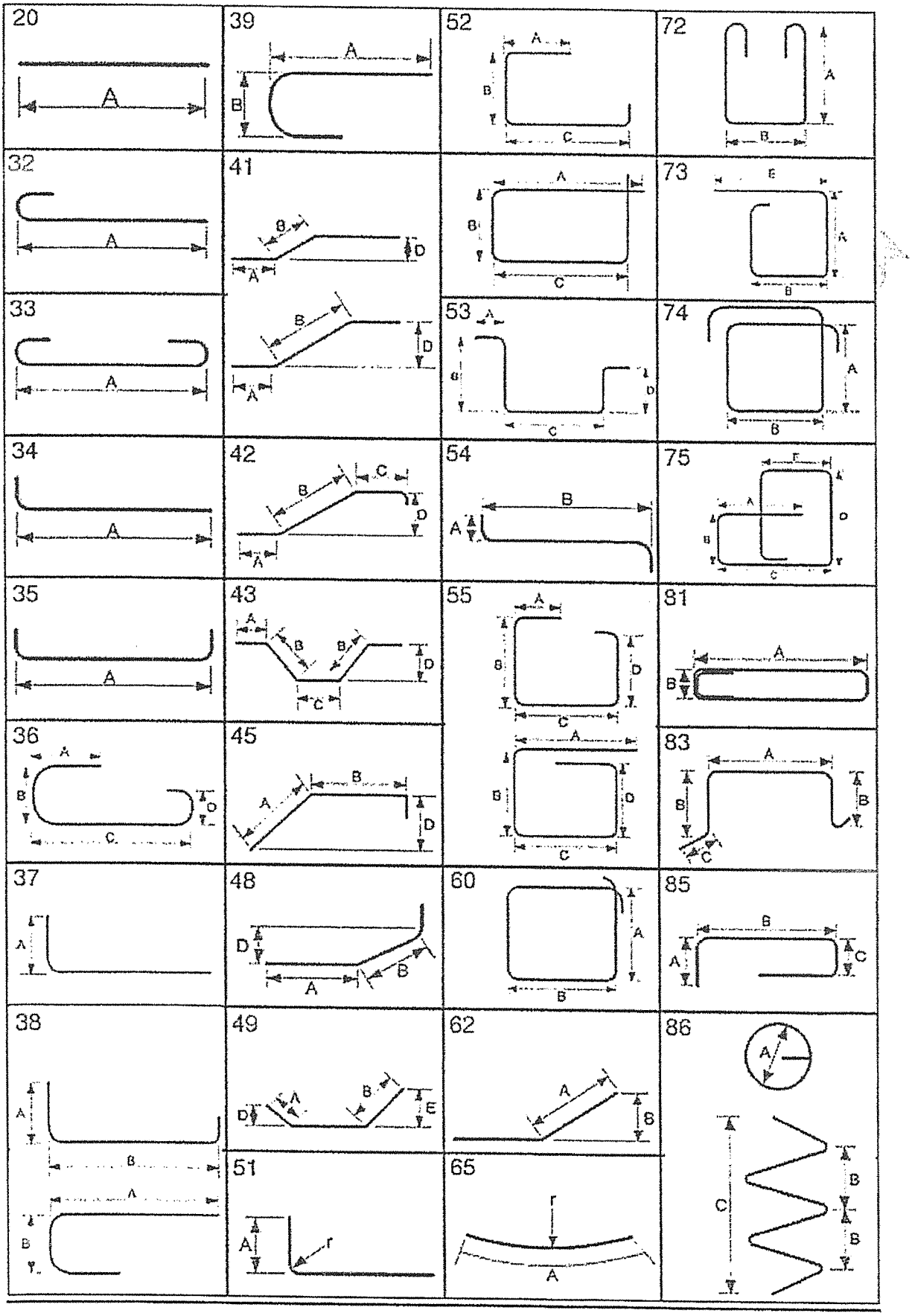
$I_{xx} = \frac{BD^3}{12} - \frac{bd^3}{12}$



$I_x = \frac{bh^3}{36}$

$\sigma \quad \pi$

SABS 82 SHAPE CODES



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

BUILDING AND STRUCTURAL CONSTRUCTION N5

13 November 2013

This marking guideline consists of 8 pages.

QUESTION 1

1.1 Tearing stress $= \frac{\text{Load}}{\text{Area}} = \frac{\text{Force}}{(B \times t) - n(d \times t)}$.

$$\sigma_{tearing} = \frac{350 \times 10^3}{(122 \times 6) - 3(14 \times 6)}.$$

$$= \underline{729{,}167 \text{ MPa}} \rightarrow$$

(3)

1.2 Shear stress $= \frac{\text{Load}}{2 \times n \times \pi \times D^2/4}$.

$$D^2 = \frac{4 \times \text{Load}}{Pv \times 2 \times n \times \pi} = \frac{4 \times 85 \times 10^3}{100 \times 2 \times 3 \times \pi}.$$

$$D = \sqrt{180{,}376}$$
$$= 13{,}430 \quad \text{Thus } \underline{14 \text{ mm Bolts}} \rightarrow$$

(4)

1.3 Crushing stress $= \frac{\text{Load}}{n \times d \times t}$.

$$= 250 \times 3 \times 16 \times 6$$

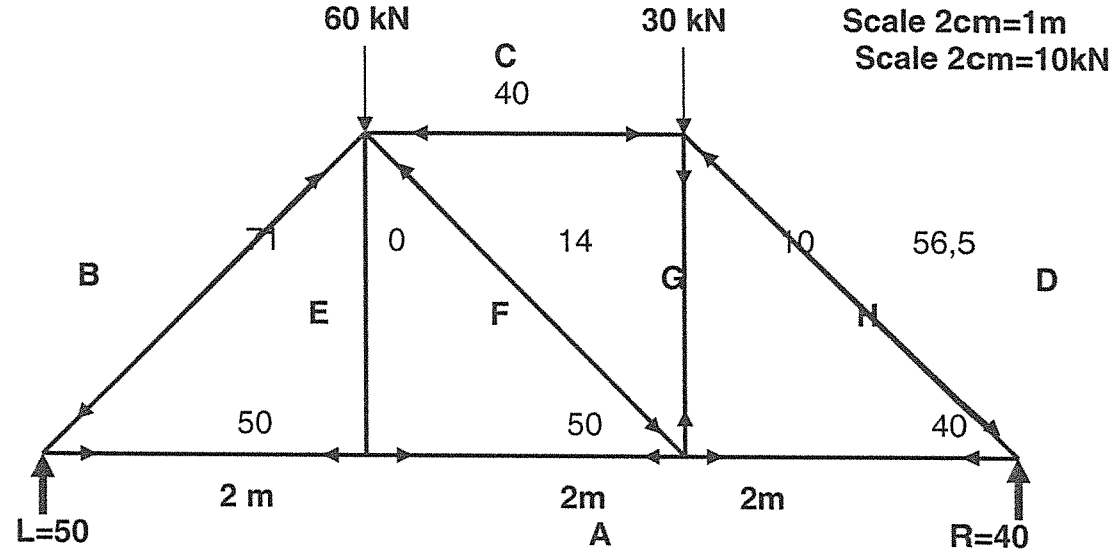
$$= 72000 \text{ N}$$

$$= 72 \text{ kN}$$

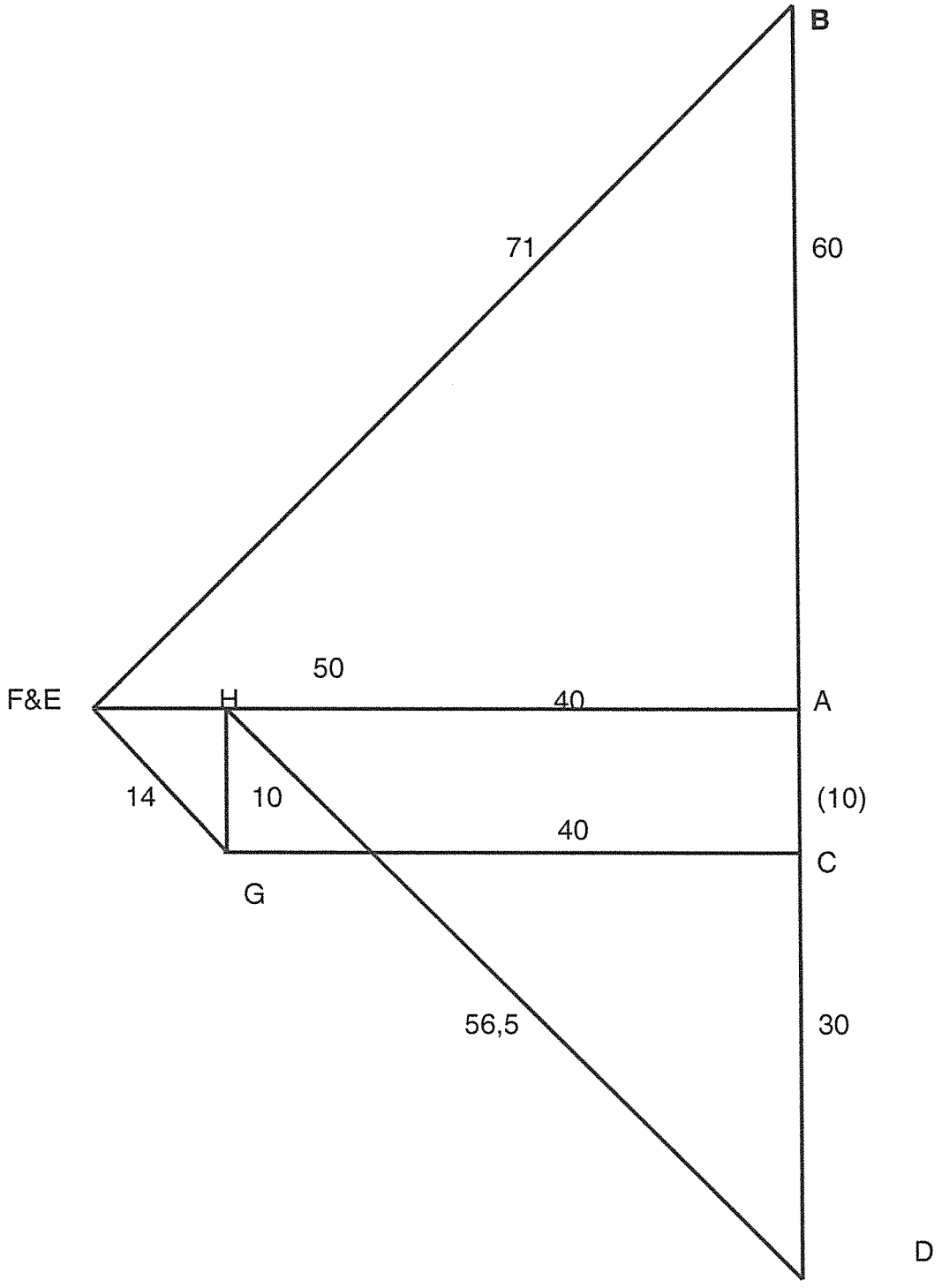
(4)
[11]

QUESTION 20

Frame Diagram **Scale 2cm=1m**



Force Diagram
Scale 2cm=10kN



[20]

QUESTION 3

	Area	Y-Dist	A x Y	I_{xx}	$\frac{bh^3}{12}$	Dist to NA (d)	A x d^2
1	A=LxB + 168	6	1008	$\frac{bh^3}{12}$	+2016	2,507	+ 421,176
2	A=LxB - 48	5	- 240	$\frac{bh^3}{12}$	- 144	3,507	- 168,336
3	A=½BxH + 84	16	+1344	$\frac{bh^3}{36}$	+ 672	7,493	+ 629,412
4	A=πr^2 - 50,265	16	- 804,248	$\frac{\pi.d^4}{64}$	- 201,062	7,493	- 376,636
	∑ 153,735		∑ 1307,752		∑ 2342,938		∑ 505,616

3.1
$$Y = \frac{\sum A \times Y}{\sum A}$$
$$Y = \frac{1307,752}{153,735}$$
$$Y = 8,507 \text{ mm } \surd\surd$$

(2)

3.2
$$Ixx = \sum (INA + Ad^2)$$
$$= 2342,938 + 505,616$$
$$= 2848,554 \text{ cm}^4$$
$$Ixx = 2848,554 \text{ cm}^4 \surd\surd\surd\surd$$

(4)

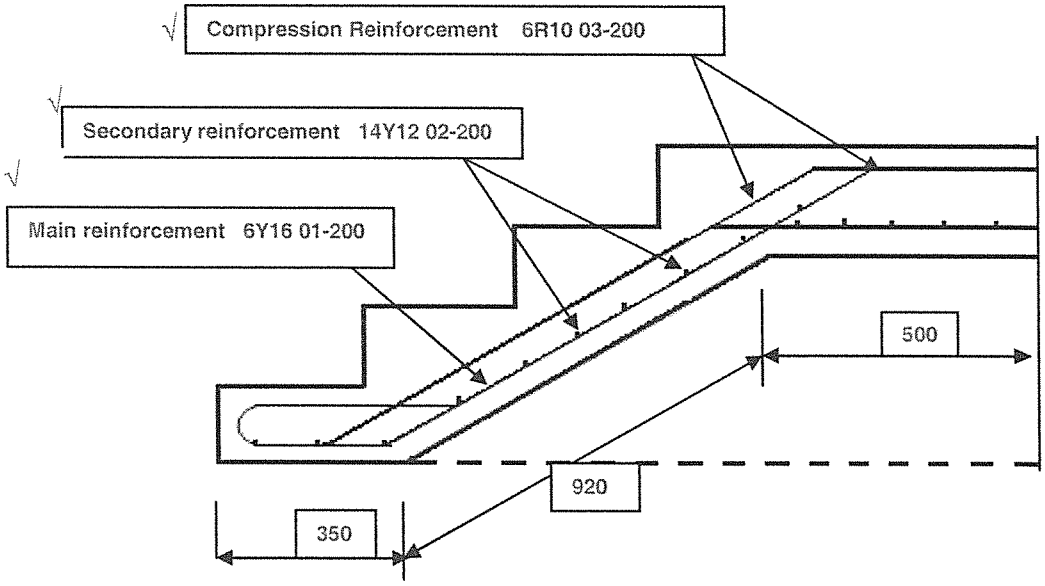
3.3
$$Z = {}^{I}/_{Y}$$
$$Z = \frac{2848,554}{8,507}$$
$$Z = 334,848 \text{ cm}^3 \surd\surd$$

(2)

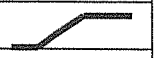
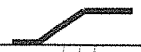
3.4
$$BMomax = \text{stress x } Ze$$
$$= 155\text{MPa x } 334,848 \text{ cm}^3$$
$$= 51901,4776 \text{ KNcm } \surd\surd$$

(2)
[10]

QUESTION 4

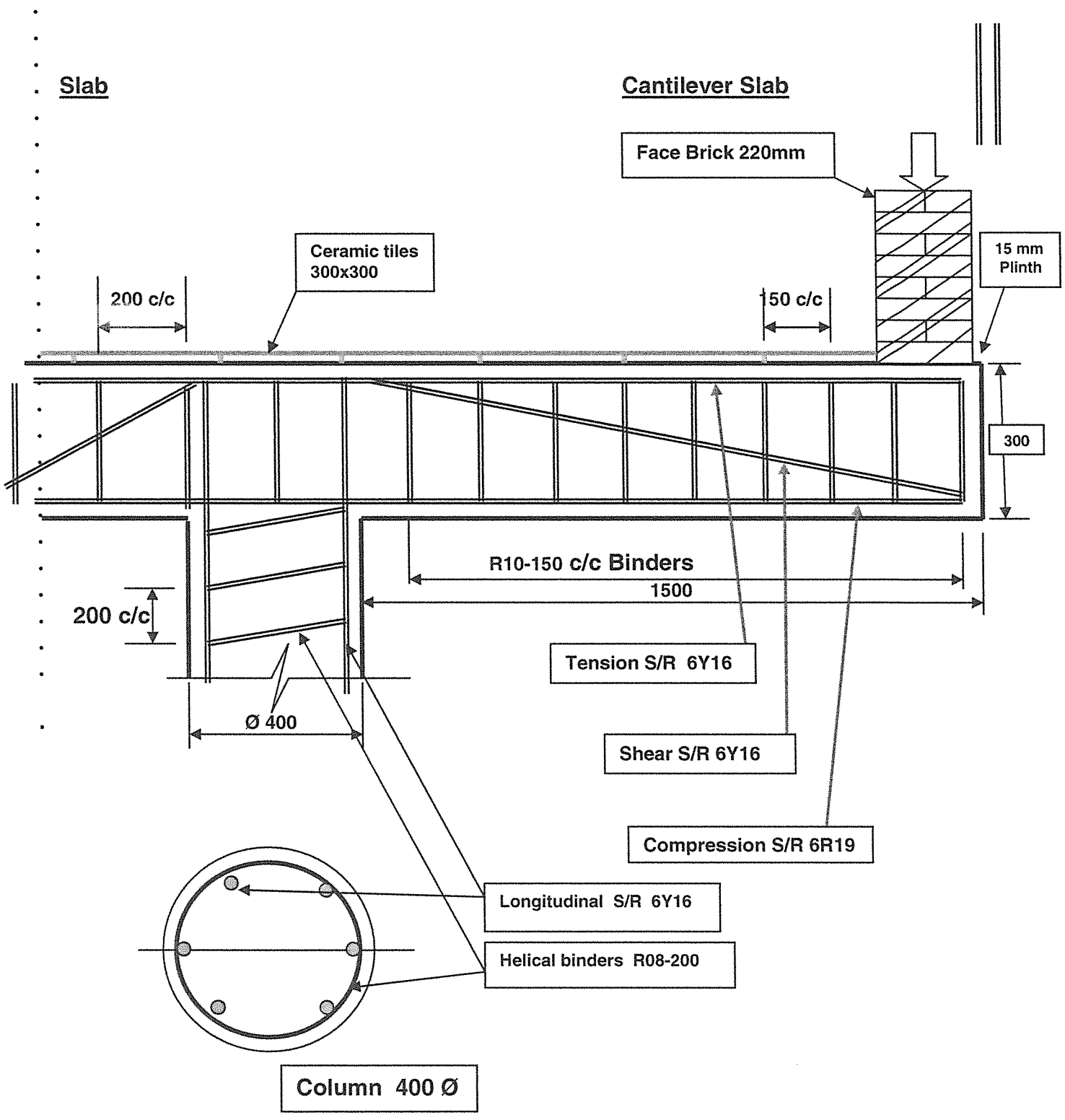


(3)

1	2	3	4	5	6	7	8
Member	**Bar mark**	**Type and size**	**No of members**	**No in each**	**Total number**	**Length of each bar**	**Shape**
C/stair	1	Y16	5	6	30	1700	
Stair	2	Y12	5	14	70	1000	
stair	3	R10	5	6	30	1700	
√	√	√√√	√	√√√	√	√√√	√√√

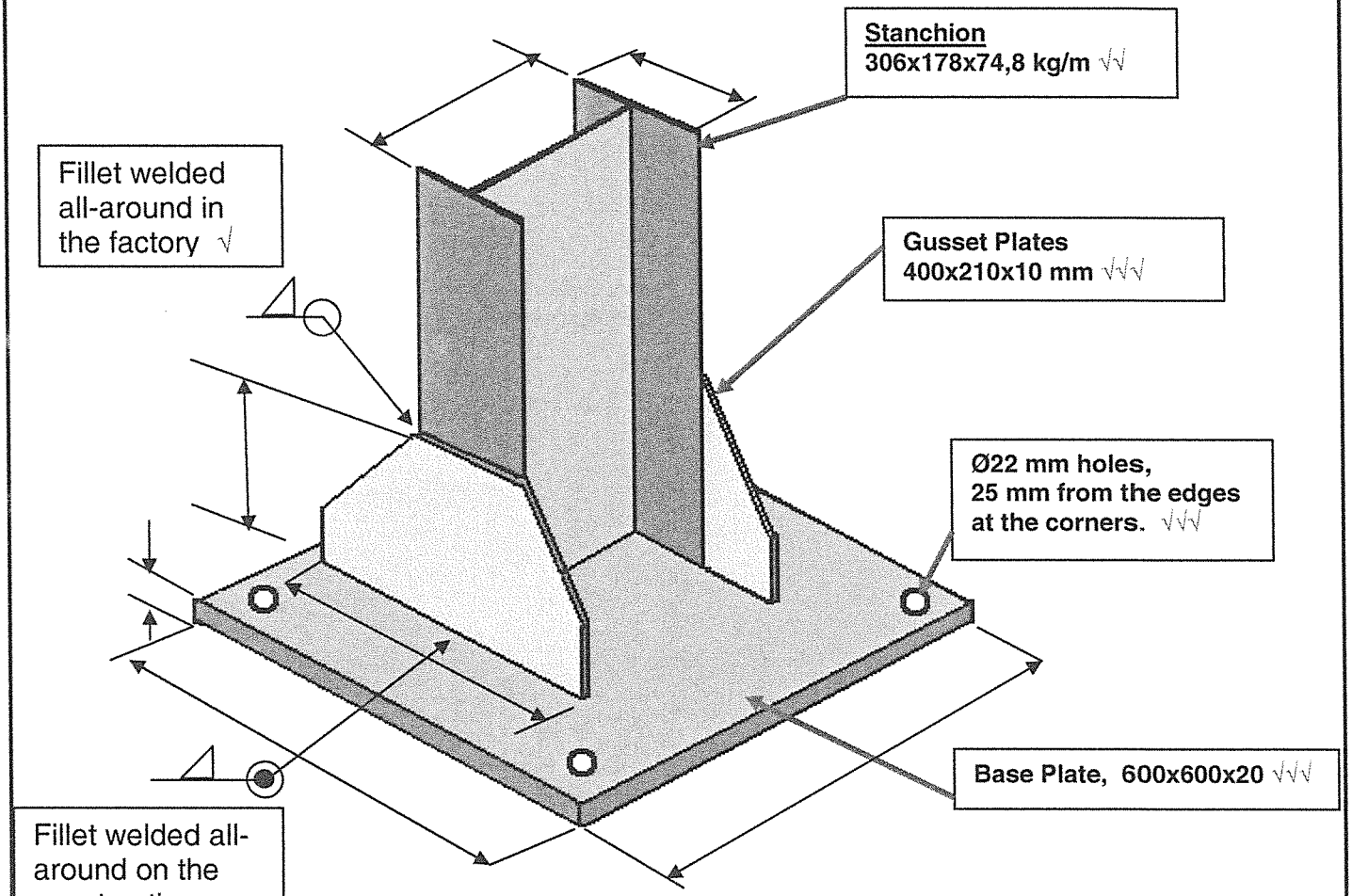
(16)
[19]

QUESTION 5



[22]

QUESTION 6



[14]

QUESTION 7

7.1	Helical binder	(1)
7.2	Diameter	(1)
7.3	Pitch distance	(1)
7.4	Total length of the spiral	(1)
		[4]

TOTAL: 100