



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

BUILDING SCIENCE N3

28 July 2021

This marking guideline consists of 7 pages.

NOTE: ✓ = Mark
 ✓ = ½ Mark

QUESTION 1

- Place the cone on a non-absorbent flat surface. Place your feet firmly on the foot grips to hold the cone steady. ✓✓
- Place 3–4 layers of 75 mm fresh concrete in the cone. ✓✓
- Tamp each layer 25 times. ✓✓
- Raise the cone and place alongside the concrete. ✓✓
- Measure the difference between the two levels. ✓✓

(5 × 2) [10]

QUESTION 2

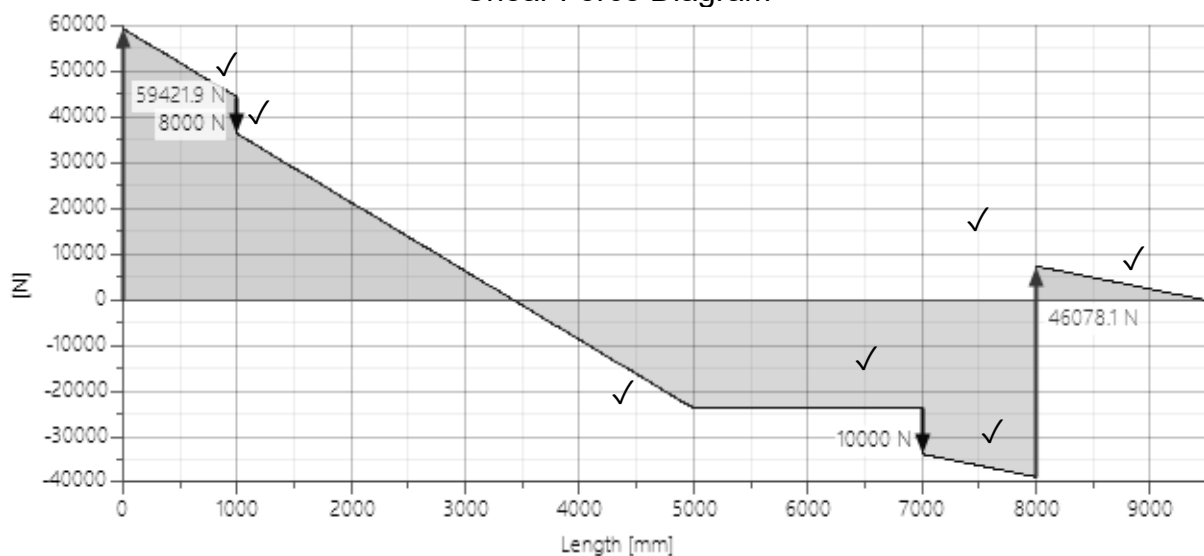
- 2.1 Taking moments about RL
 $8RR = (5 \times 2.5 \times 8.25) + (10 \times 7) + (15 \times 5 \times 2.5) + (8 \times 1)$
 $RR = 46,08 \text{ kN}$ ✓

Taking moments about RR
 $8RL = (8 \times 7) + (15 \times 5 \times 5.5) + (10 \times 1) + (5 \times 0.5) - (5 \times 1.5 \times 0.75)$ ✓
 $RL = 59,42 \text{ kN}$ ✓

(4)

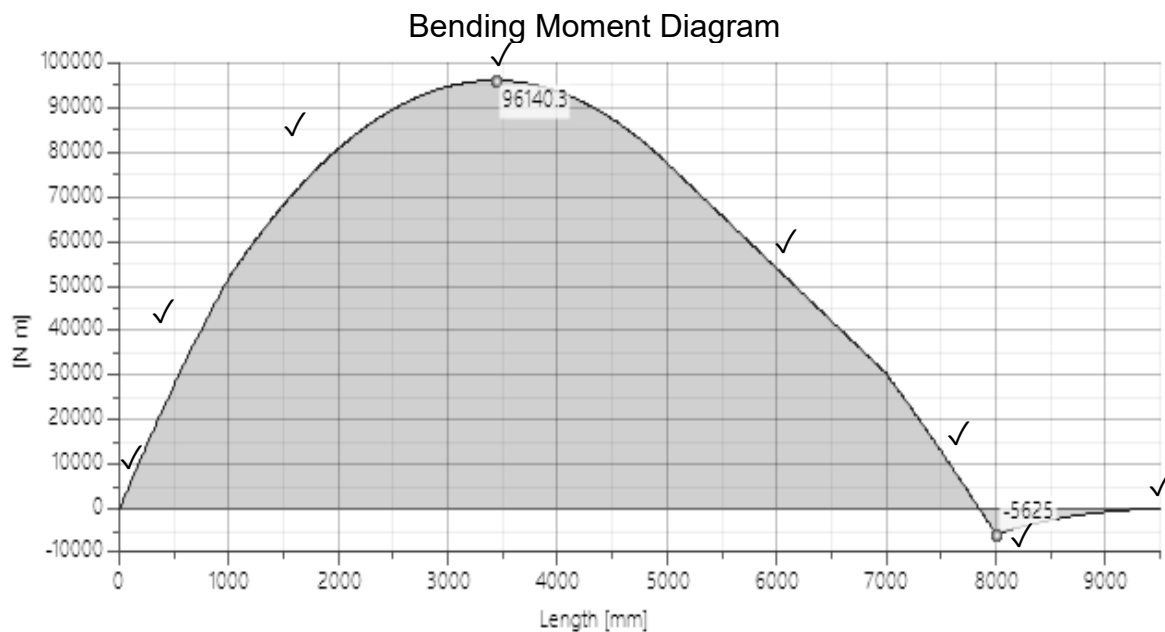
2.2

Shear Force Diagram



(8)

2.3



(8)

[20]**QUESTION 3**

3.1 Taking moments about the right-hand support

$$10R_L = (7 \times 8,73) + (8 \times 5) + (5 \times 1,27) \checkmark$$

$$R_L = 10.75 \text{ kN} \checkmark$$

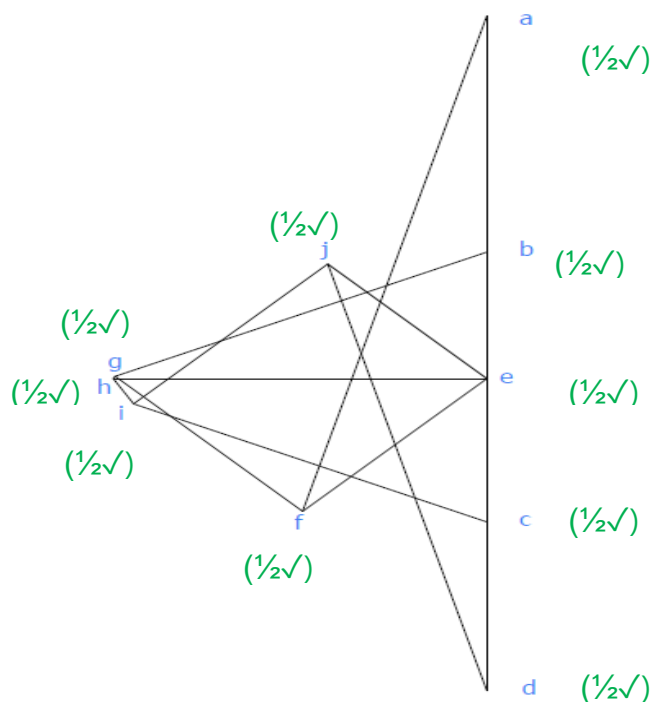
(2)

Taking moments about the left-hand support

$$10R_R = (7 \times 1,27) + (8 \times 5) + (5 \times 8,73) \checkmark$$

$$R_R = 9.25 \text{ kN} \checkmark$$

(2)



(5)

MEMBER	MAGNITUDE	NATURE
AF	15.2 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
BG	8.75 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
CI	7.8 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
DJ	13.09 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
EJ	4.80 KN ($\frac{1}{2}\checkmark$)	Tie ($\frac{1}{2}\checkmark$)
EH	7.97 KN ($\frac{1}{2}\checkmark$)	Tie ($\frac{1}{2}\checkmark$)
EF	5.56 KN ($\frac{1}{2}\checkmark$)	Tie ($\frac{1}{2}\checkmark$)
FG	5.66 KN ($\frac{1}{2}\checkmark$)	Tie ($\frac{1}{2}\checkmark$)
GH	0.08 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
HI	2 KN ($\frac{1}{2}\checkmark$)	Strut ($\frac{1}{2}\checkmark$)
IJ	5.86 ($\frac{1}{2}\checkmark$)	Tie ($\frac{1}{2}\checkmark$)

(11)
[20]**QUESTION 4**

- 4.1
- Graphical $\checkmark$
 - Analytical $\checkmark$

(2)

4.2

SHAPE	AREA (mm ²)	X (mm)	Y (mm)	AX (mm ³)	AY (mm ³)	Marks
Rectangle (A)	2 200 × 200 = 440 000 $\frac{1}{2}\checkmark$	1 100 $\frac{1}{2}\checkmark$	100 $\frac{1}{2}\checkmark$	484 000 000 $\frac{1}{2}\checkmark$	440 000 000 $\frac{1}{2}\checkmark$	(2 $\frac{1}{2}$)
Triangle (B)	$\frac{1}{2} \times 400 \times 600$ = 120 000 $\frac{1}{2}\checkmark$	566,67 $\frac{1}{2}\checkmark$	400 $\frac{1}{2}\checkmark$	68 000 400 $\frac{1}{2}\checkmark$	48 000 000 $\frac{1}{2}\checkmark$	(2 $\frac{1}{2}$)
Triangle (C)	$\frac{1}{2} \times 400 \times 600$ = 120 000 $\frac{1}{2}\checkmark$	1 633,33 $\frac{1}{2}\checkmark$	400 $\frac{1}{2}\checkmark$	195 999 600 $\frac{1}{2}\checkmark$	48 000 000 $\frac{1}{2}\checkmark$	(2 $\frac{1}{2}$)
Rectangle (D)	800 × 600 = 480 000 $\frac{1}{2}\checkmark$	1100 $\frac{1}{2}\checkmark$	500 $\frac{1}{2}\checkmark$	528 000 000 $\frac{1}{2}\checkmark$	240 000 000 $\frac{1}{2}\checkmark$	(2 $\frac{1}{2}$)
Circle (E)	$\pi \times 300^2/4$ = -70 685,83 $\frac{1}{2}\checkmark$	1 100 $\checkmark$	500 $\frac{1}{2}\checkmark$	-777 544 13 $\frac{1}{2}\checkmark$	-353 429 15 $\frac{1}{2}\checkmark$	(2 $\frac{1}{2}$)
TOTAL	1 089314.17 $\frac{1}{2}\checkmark$			1198245587 $\frac{1}{2}\checkmark$	740 657 085 $\frac{1}{2}\checkmark$	(1 $\frac{1}{2}$)

$$\begin{aligned}\bar{x} &= \Sigma Ax / \Sigma A \\ &= 1198245587 / 1089314,17 \checkmark \\ &= 1\,100 \text{ mm} \checkmark\end{aligned}$$

$$\begin{aligned}\bar{y} &= \Sigma Ay / \Sigma A \\ &= 740657085 / 1089314,17 \checkmark \\ &= 679,93 \text{ mm} \checkmark\end{aligned}$$

(18)
[20]**QUESTION 5**

5.1 Velocity ratio = wheel diameter/axle diameter
 $= (400/55) \checkmark$
 $= 7,5 \checkmark \checkmark$

5.2 Efficiency = load (effort $\times$ velocity ratio)
 $0.94 = (50 \times 9.81) \checkmark / (P \times 7.27) \checkmark$
 $P = 71.28 \text{ N} \checkmark$

5.3 Mechanical advantage = velocity ratio $\times$ efficiency $\checkmark$
 $= 7,27 \times 0,94 \checkmark$
 $= 6.83 \checkmark$

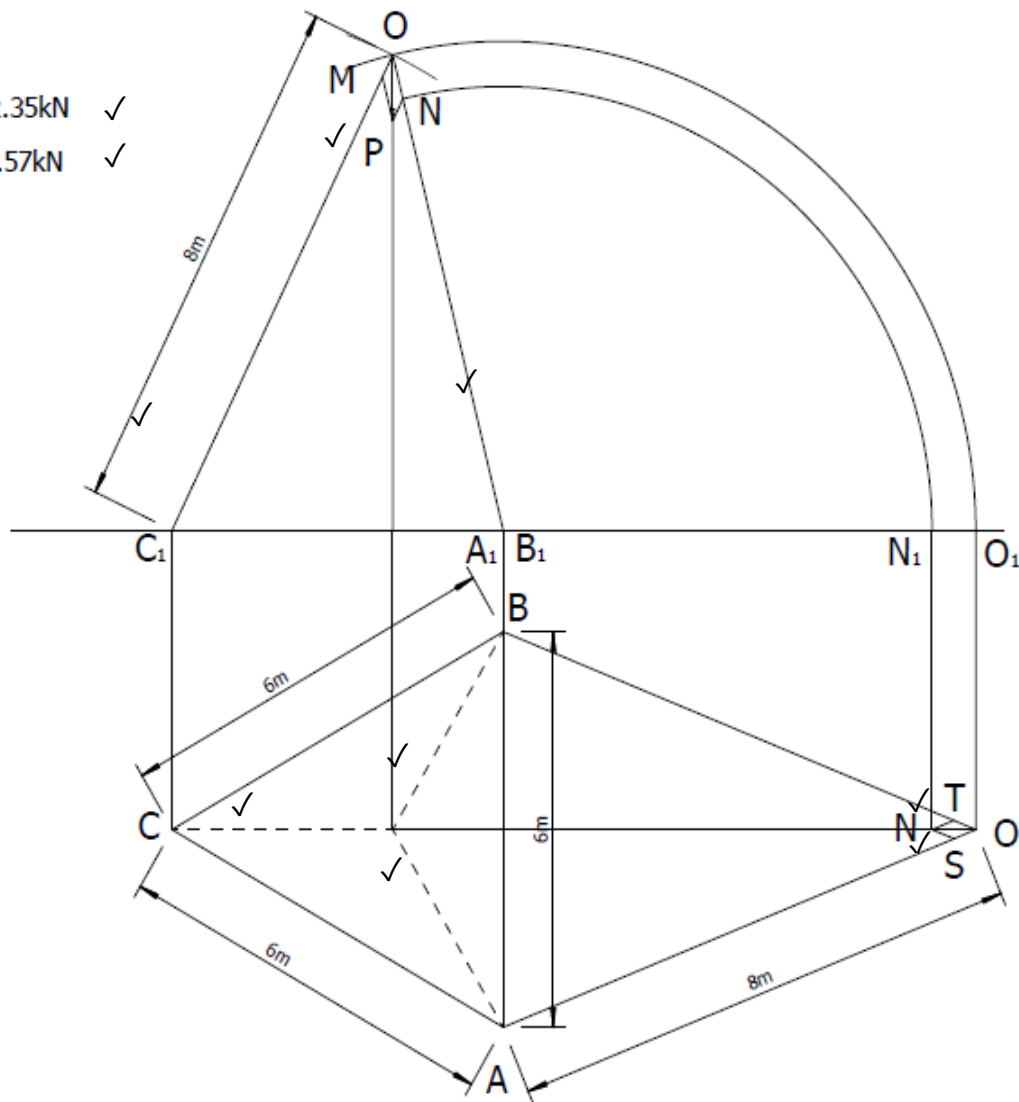
(3 $\times$ 3)

[9]

QUESTION 6

$$OM = 2.35\text{kN} \quad \checkmark$$

$$OS = 2.57\text{kN} \quad \checkmark$$



[11]

QUESTION 7

7.1

- Copper ✓
- Aluminium ✓
- Silver ✓
- Mercury ✓
- Steel ✓
- Zinc ✓
- Nickel ✓
- Iron ✓
- Platinum ✓
- Lead ✓
- Brass ✓
- Gold ✓

(Any 4 × 1)

(4)

7.2	• Hydraulic magnetic circuit breaker (HMCB) ✓ • Thermal magnetic circuit breaker (TMCB) ✓ • Moulded case circuit breaker (MCCB) ✓ • Air magnetic circuit breakers(AMCB) ✓ • Oil circuit breaker (OCB) ✓ • Sulfurhexafluoride (SF6) circuit breaker (SF6CB) ✓	(Any 2 × 1)	(2)
7.3	• Rubber ✓ • Polythene ✓ • PVC✓ • Perspex ✓ • China✓ • Air ✓	(Any 2 × 1)	(2)
7.3	Power = voltage × current Current = power/voltage = 60/220✓ = 0,27A✓		(2) [10]
TOTAL:			100