



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

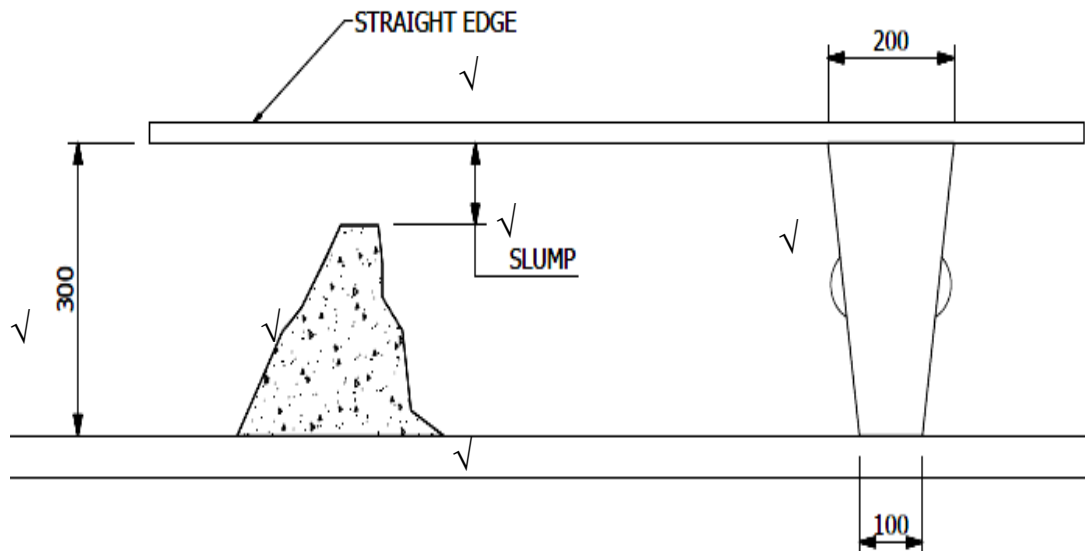
BUILDING SCIENCE N3

29 MARCH 2018

This marking guideline consists of 8 pages.

QUESTION 1

Hold the slump mould in position and fill it with concrete in four equal layers, rodding (poking) each layer exactly 25 times.✓ Strike off surplus concrete from the cone and clear droppings around the base.✓ Lift the cone off steadily, vertically and place the cone alongside the slumped concrete.✓ Place a straight edge across it and measure the difference in height.✓ The slump is now measured and recorded as a collapse or shear slump.✓

**[8]****QUESTION 2**

2.1 2.1.1 $+\uparrow \Sigma M_{RR} = -\downarrow \Sigma M_{RR}$
 $4,5RL = 3 \times 2 \times 3,5 + 4 \times 1,5 \times 1,75 + 1 \times 1 \times 0,5$ ✓
 $RL = 32/4,5$ ✓
 $= 7,11 \text{ kN}$ ✓

(3)

2.1.2 $+\uparrow \Sigma M_{RL} = -\downarrow \Sigma M_{RL}$
 $4,5RR = 3 \times 2 \times 1 + 4 \times 1,5 \times 2,75 + 1 \times 1 \times 4$ ✓
 $RR = 26,5/4,5$ ✓
 $= 5,89 \text{ kN}$ ✓

OR

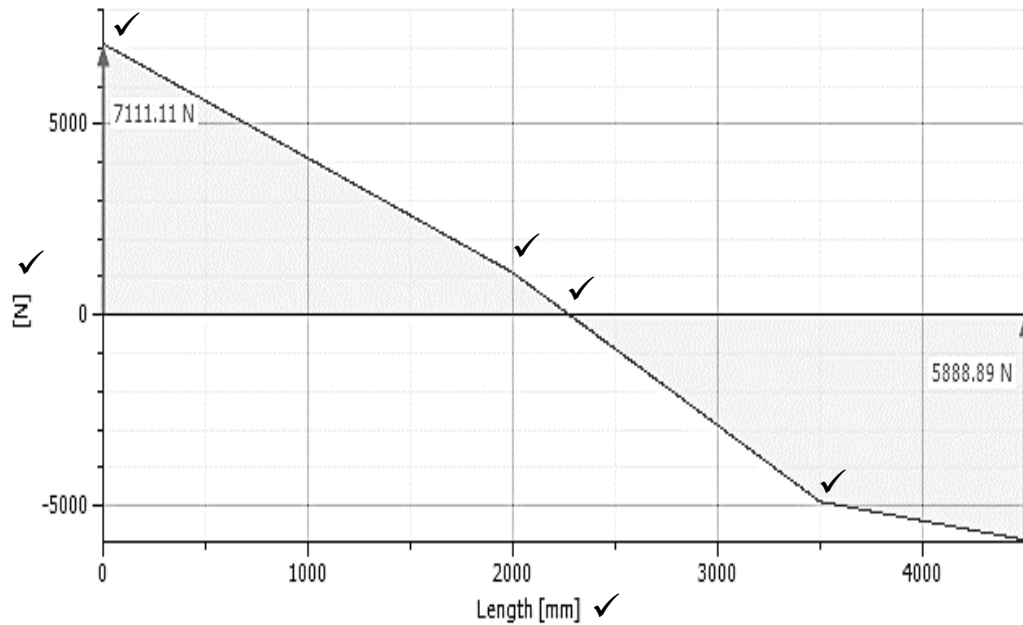
$+\uparrow \Sigma F = -\downarrow \Sigma F$
 $RR + RL = 3 \times 2 + 4 \times 1,5 + 1 \times 1$ ✓
 $= 13 \text{ kN}$ ✓
 But $RL = 7,11 \text{ kN}$
 $\therefore RR = 13 - 7,11$
 $= 5,89 \text{ kN}$ ✓

(3)

2.2

Shear force diagram

Linear scale: 1 cm : 0,5 m // Shear force scale: 0,5cm : 1 kN

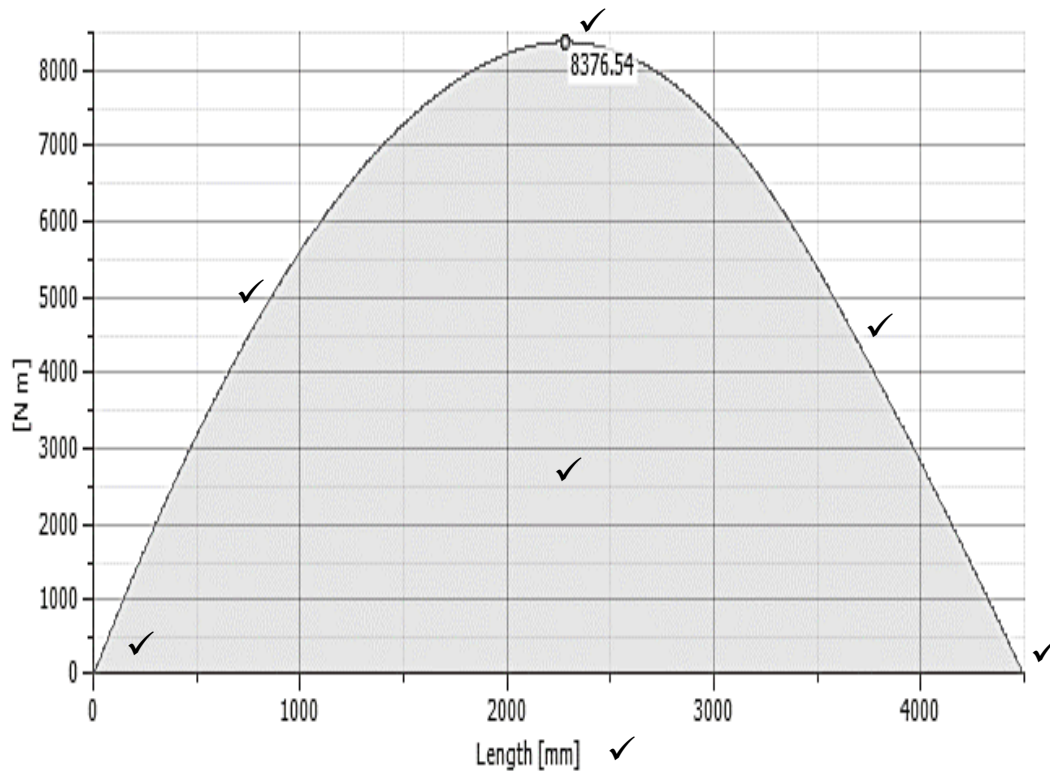


✓ (7)

2.3

Bending moment diagram

Linear scale: 1 cm : 0,5 m // Bending moment scale: 1 cm : 1 kNm

(7)
[20]

QUESTION 3

- 3.1
- Must be easy to replace
 - Must not deteriorate with age
 - Must be well isolated to avoid shock
 - Must carry rated current without deteriorating
 - Must be totally enclosed so that there is no external flush when it ruptures
- (Any 4 × 1) (4)

3.2 Energy = power × time

But power = I^2R

$$\therefore E = I^2Rt \checkmark$$

$$= 3^2 \times 3 \times 1 \times 60 \times 60 \checkmark$$

$$= 97,2 \text{ kJ} \checkmark$$

OR

$$V = IR$$

$$= 3 \times 3$$

$$= 9 \text{ V} \checkmark$$

$$P = VI$$

$$= (9)(3) \checkmark$$

$$= 27 \text{ W} \times 1 \text{ hr} = 27 \text{ Wh} \times 3\,600 = 97,2 \text{ kJ} \checkmark$$

(3)

3.3 Daily energy consumption:

$$E_{\text{day}} = I^2Rt$$

$$= 3^2 \times 3 \times 5/60 \checkmark$$

$$= 2,25 \text{ Wh per day} \checkmark$$

\therefore Total energy consumption in 5 days:

$$E_{\text{total}} = E_{\text{day}} \times \text{number of days}$$

$$= 2,25 \times 5$$

$$= 11,25 \text{ Wh} \checkmark$$

$$= 11,25 / 1\,000 = 0,01125 \text{ kWh} \checkmark$$

\therefore Total cost = $E_{\text{total}} \times \text{unit price}$

$$= 0,01125 \times 1,35 \checkmark$$

$$= 0,0151875/100$$

$$= 1,52 \text{ cents} \checkmark$$

(5)
[12]

QUESTION 4

- 4.1
- Rainwater gutters
 - Rainwater downpipes
 - Barge board
 - Water pipes
 - Drainage pipes
 - Socket outlets
 - Electrical conduits
 - Electrical switches
 - DPC
 - Pipe fittings (adapters, reducers, etc.)
- (Any 4 × 1) (4)
- 4.2
- Velocity ratio = diameter of wheel/diameter of axle
 $= 450/65✓$
 $= 6,92✓$
- Actual effort = $w/(v.r \times \eta)$
 $= 400/(6,92 \times 0,95)✓$
 $= 60,84 \text{ n}✓$
- Mechanical advantage = $v.r \times \eta$
 $= 6,92 \times 0,95✓$
 $= 6,574✓$
- (6)
[10]

QUESTION 5

- 5.1
- Provides a continuous protective film when dry
 - Protective film should adhere to the surface to which it is applied (adhesion)
 - Should be plastic enough to expand and contract with the surface on which it is applied
 - Should withstand weather elements to which it is exposed
 - Should be economic
 - Should be easy to apply
 - Should have reasonable spreading and covering capacity (opacity)
- (Any 5 × 1) (5)
- 5.2
- Wipe of any dirt and oil on the iron sheet using thinners.
 - Apply the first coat of red oxide primer on the clean galvanised iron sheet.
 - Wait for the primer to dry before applying a second coat.
 - Apply the first coat of paint and leave it to dry (air-drying or oven-drying).
 - Apply the second coat of paint and leave it to dry (air-drying or oven-drying).
- (Any 5 × 1) (5)
[10]

QUESTION 6

SHAPE	AREA [mm ²]	ON [mm]	OM [mm]	A _{ON} [mm ³]	A _{OM} [mm ³]
A	90×80 $= 7\,200 \checkmark$	$45 \checkmark$	$40 \checkmark$	$7\,200 \times 45$ $= 324\,000 \checkmark$	$7\,200 \times 40$ $= 288\,000 \checkmark$
B	$= -\frac{1}{2} \times \pi \times$ 45^2 $= -3\,180,86 \checkmark$	$45 \checkmark$	$80 - (4 \times$ $45)/3\pi$ $= 60,90 \checkmark$	$3\,180,86 \times$ 45 $= -143\,138,7$ \checkmark	$-3\,180,86 \times$ $60,90$ $= -193\,714,37$ \checkmark
C	38×120 $= 4\,560 \checkmark$	$109 \checkmark$	$60 \checkmark$	$4\,560 \times 109$ $= 497\,040 \checkmark$	$4\,560 \times 60$ $= 273\,600 \checkmark$
D	82×40 $= 3\,280 \checkmark$	$169 \checkmark$	$20 \checkmark$	$3\,280 \times 169$ $= 554\,320 \checkmark$	$3\,280 \times 20$ $= 65\,600 \checkmark$
E	$\frac{1}{2} \times 42 \times 80$ $= 1\,680 \checkmark$	$142 \checkmark$	$40 + \frac{1}{3}$ $\times 80$ $= 66,67 \checkmark$	840×142 $= 238\,560 \checkmark$	$840 \times 66,67$ $= 112\,005,80 \checkmark$
F	35×80 $= 2\,800 \checkmark$	$227,5 \checkmark$	$20 \checkmark$	$2\,800 \times$ $227,5$ $= 637\,000 \checkmark$	$2\,800 \times 20$ $= 56\,000 \checkmark$
G	35×120 $= 4\,200 \checkmark$	$262,5 \checkmark$	$60 \checkmark$	$4\,200 \times$ $262,5$ $= 1\,102\,500 \checkmark$	$4\,200 \times 60$ $= 252\,000 \checkmark$
TOTAL SUM	$20\,539,14 \checkmark$			$3\,210\,281,30$	$853\,491,43$

$$\bar{X} = \Sigma AX / \Sigma A$$

$$= 3\,210\,281,30 / 20\,539,14 \checkmark$$

$$= 156,30 \text{ mm } \checkmark$$

$$\bar{Y} = \Sigma AY / \Sigma A$$

$$= 853\,491,43 / 20\,539,14 \checkmark$$

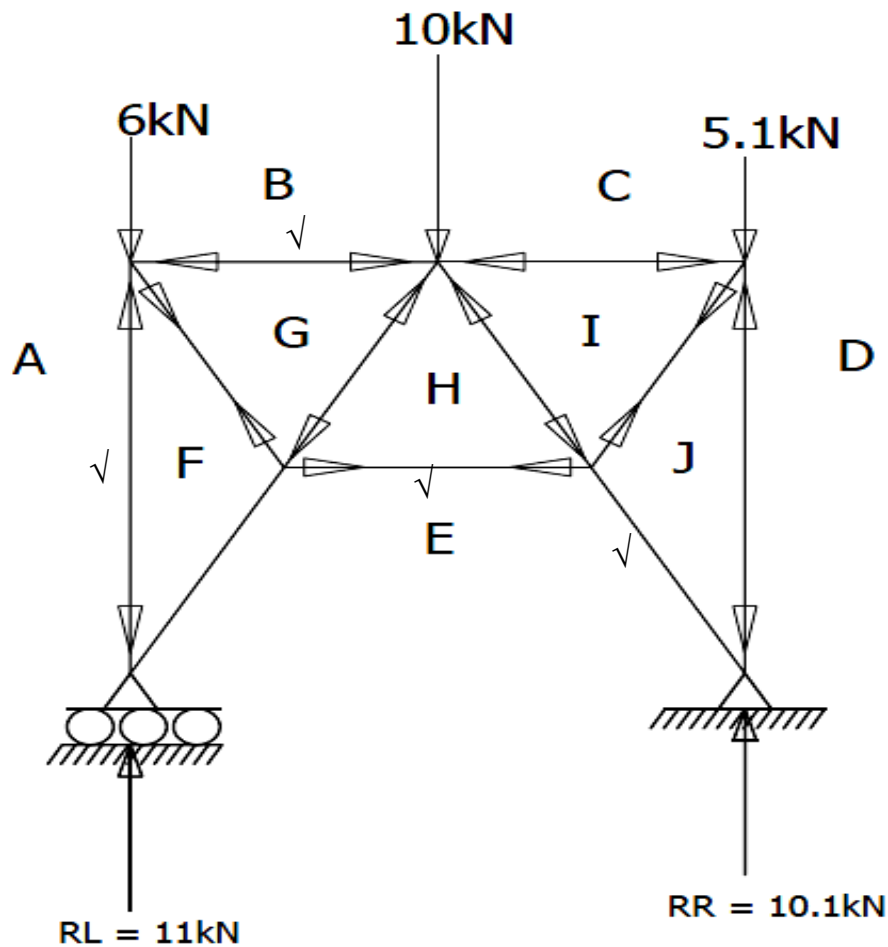
$$= 41,55 \text{ mm } \checkmark$$

(40 x ½)

(20)
[20]

QUESTION 7

7.1



(4 x ½)

(2)

7.2 $+\uparrow \Sigma M_{RR} = -\downarrow \Sigma M_{RR}$

$$2,31RL = 10 \times 1,155 + 6 \times 2,31 \quad \checkmark$$

$$RL = 25,41/2,31 \quad \checkmark$$

$$= 11 \text{ kN} \quad \checkmark$$

$$+\uparrow \Sigma F = -\downarrow \Sigma F$$

$$RL + RR = 6 + 10 + 5,1 \quad \checkmark$$

$$\text{But } RL = 11$$

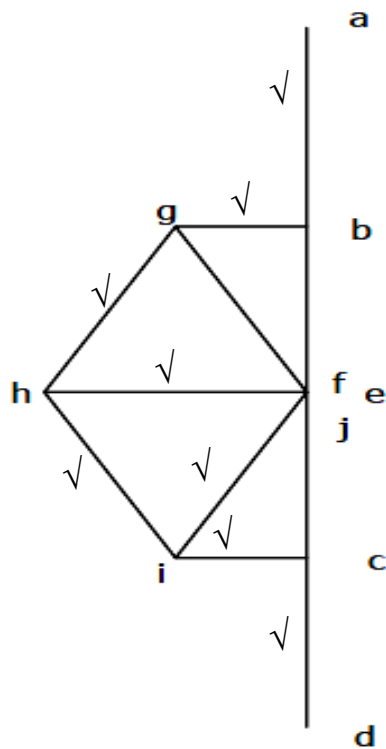
$$\therefore RR = 21,10 - 11 \quad \checkmark$$

$$\equiv 10,1 \text{ kN} \quad \checkmark$$

(6 x ½)

(3)

7.3



(8 x ½)

(4)

7.4

MEMBER	MAGNITUDE (kN)	NATURE
AF	11 ✓	Tie ✓
BG	2,9 ✓	Tie ✓
CI	2,9 ✓	Tie ✓
DJ	10,1 ✓	Tie ✓
EF	0 ✓	Redundant ✓
FG	5,8 ✓	Strut ✓
GH	5,8 ✓	Strut ✓
HI	5,8 ✓	Strut ✓
EH	5,8 ✓	Tie ✓
IJ	6,0 ✓	Strut ✓
EJ	0 ✓	Redundant ✓

(22 x ½)

(11)

[20]

TOTAL: 100