



LAMINATA MOTORWAY FENCE 2.0M HIGH **ONTO GOOD GROUND**

FOR

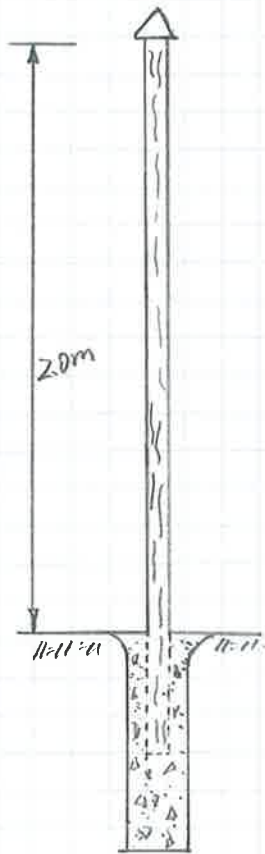
DOWNERS

FOR

ISSAC LINDSAY
LAMINATA

Job No: 18-130
Date: AUG 2018

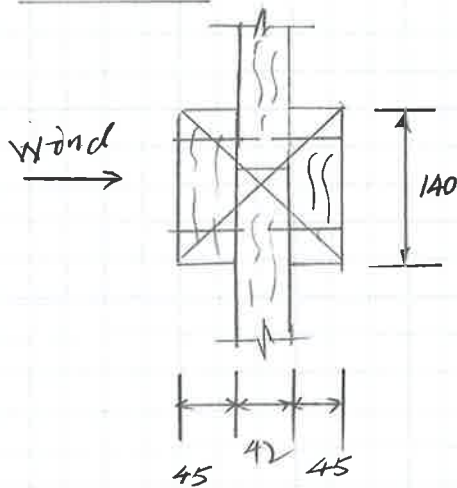
MOTORWAY FENCE



Posts at 1800 mm c/c
LAMINATED HORIZONTAL PAIRS.
Importance level of structure \rightarrow 1.0
Design working life \sim 50 years

check the maximum wind load the
laminated fence can take.

CASE A



$$\text{Area, } A = (45 \text{ mm} + 42 \text{ mm} + 45 \text{ mm}) (140 \text{ mm})$$

$$= 18480 \text{ mm}^2$$

Elastic modulus, Z

$$Z = \frac{(140 \text{ mm})(132 \text{ mm})^2}{6}$$

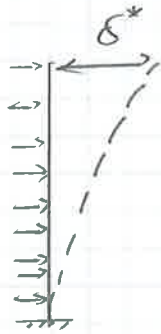
$$= 406569 \text{ mm}^3$$

Second moment of inertia, I

$$I = \frac{(140 \text{ mm})(132 \text{ mm})^3}{12}$$

$$= 2.683 \times 10^7 \text{ mm}^4$$

maximum allowance for deflection:



$$\delta^* \leq h/250 = 8 \text{ mm}$$

as it is cantilever edge

$$\delta^* \leq 16 \text{ mm}$$

$$A = \frac{wl^4}{8EI}$$

$$= \frac{w(2\text{m})^4}{8 \times 7.5 \text{ GPa} \times 2.683 \times 10^7 \text{ mm}^4}$$

$$\leq 16 \text{ mm}$$

$$\Rightarrow w \leq \frac{(16 \text{ mm})(8 \times 7.5 \text{ GPa})(2.683 \times 10^7 \text{ mm}^4)}{(2\text{m})^4}$$

$$\leq 16 \text{ kN/m}$$

consider $t_w = 1.68 \text{ m}$.

$$q = \frac{16 \text{ kN/m}}{1.68 \text{ m}}$$

$$= 9.52 \text{ kPa}$$

$$q = (1.2) \left(\frac{0.6 V_D^2}{1000} \right)$$

$$\Rightarrow V_D = 36.36 \text{ m/s}$$

wind speed

$$V_{\text{max}} = 36.36 \text{ m/s} / 0.83$$

$$= 43.8 \text{ m/s}$$

$$= 158 \text{ km/h}$$

check for strength

$$W = 1.6 \text{ kN/m}$$

$$M^* = \frac{WL^2}{2}$$

$$= \frac{(1.6 \text{ kN/m})(2\text{m})^2}{2}$$

$$= 3.2 \text{ kNm}$$

capacity

$$\phi_m = \phi_k f_b z$$

$$= 0.8 \times 1.0 \times 1.0 \times 1.0 \times 14 \text{ MPa} \times 406560 \text{ mm}^3$$

$$= 4.55 \text{ kNm} > M^*$$

⇒ OK

CHECK TOP HOLDER

$$L = 1.68 \text{ m}$$

$$W = (0.952 \text{ kPa})(0.28 \text{ m})$$

$$= 0.27 \text{ kN/m}$$

analyse is shown in page 4.

⇒ checks OK.

Foundation design and sketch is shown in page 5.

⇒ USE $\phi 300 \text{ mm}$ with minimum 800 mm Embedment
concrete pile.

P K ENGINEERING

STRUCTURAL & GEOTECHINAL ENGINEERS

TIMBER BEAM DESIGN

Job: 18-130
Ref: TOP HOLDER -CASE B

Date: 24MAY18
Designer: A.T.

Total span = 1.68 m Depth = 42 mm
 Lay 1.68 m Breadth = 280 mm

K factors

Load durat'n K1 0.80
 P'll'l supp't K4 1.00
 Grid system K5 1.00
 Lam. thick's K27 1.00
 K factors = K1 x K4 x K5 x K8 x K27 =

Stability

D / B = 0.15
 Lay/B = 6
 thus S = 0
 and K8 = 1.00
 K factors = 0.80

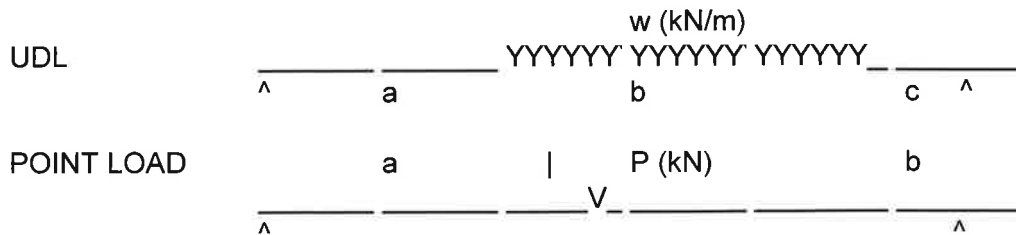
Material Properties

F'b = 11.2 MPa
 F's = 1.5 MPa
 E = 7500 MPa

Section Properties

area = 11760 mm²
 Z = 8.2E+004 mm³
 I = 1.7E+006 mm⁴

LOADS



Moments & deflections at X =

0.84 (m)

Moment at test x
 Defl'n at test x

| Ref. No. | a (m) | b (m) | loads (m) | Defl'n Factor | Ra (kN) | Rb (kN) | Xmax (m) | Mmax (kNm) | Moment at test x (kNm) | Defl'n at test x (mm) |
|----------|-------|-------|-----------|---------------|---------|---------|----------|------------|------------------------|-----------------------|
|----------|-------|-------|-----------|---------------|---------|---------|----------|------------|------------------------|-----------------------|

UDL LOADS w (kN/m)

| | | | | | | | | | | |
|---|---|------|------|---|------|------|------|------|------|-----|
| 1 | 0 | 1.68 | 0.27 | 1 | 0.23 | 0.23 | 0.84 | 0.10 | 0.10 | 2.2 |
| 2 | 0 | 1.68 | 0.00 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |
| 3 | 0 | 1 | 0.00 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |

PT LOADS P (kN)

| | | | | | | | | | | |
|---|------|------|------|-----|------|------|------|------|------|-----|
| 4 | 0.84 | 0.84 | 0.00 | 2 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.0 |
| 5 | 0.84 | 0.84 | 0.00 | 1 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.0 |
| 6 | 0 | 1.68 | 0.00 | 1.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |
| 7 | 0 | 1.68 | 0.00 | 1.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |

| | | | | | | | | | | |
|---------------|--|--|--|--|------|------|------|------|-------|-----|
| Totals | | | | | 0.23 | 0.23 | 2.52 | 0.10 | 0.095 | 2.2 |
|---------------|--|--|--|--|------|------|------|------|-------|-----|

STRESS

Max. stress: $f_b = 1.2$ MPa OK
 Allowable stress: $F_b = F_b = K \times F'b = 9.0$ MPa

DEFLECTION

Max. deflection = 2.2 mm OK
 Limit = $0.004 \times \text{span} = 6.7$ mm

POLE1

P.K.ENGINEERING LIMITED

22-Aug-18

CANTILEVER POLE DESIGN

REF : LAMINATA CASE-A

DESIGNER : PK

INPUT DATA :

Height H(m) 2.00
 Pole Dia. d(mm) 140
 Encasement B(mm) 300

DESIGN :

Total lateral force Ptot = 3.20 kN
 Max. pole moment Mp 3.20 kN-m

STRESSES :

Pole Fb = Actual 11.88 Mpa Allowable 21.7 Mpa OK

DEFLECTION;

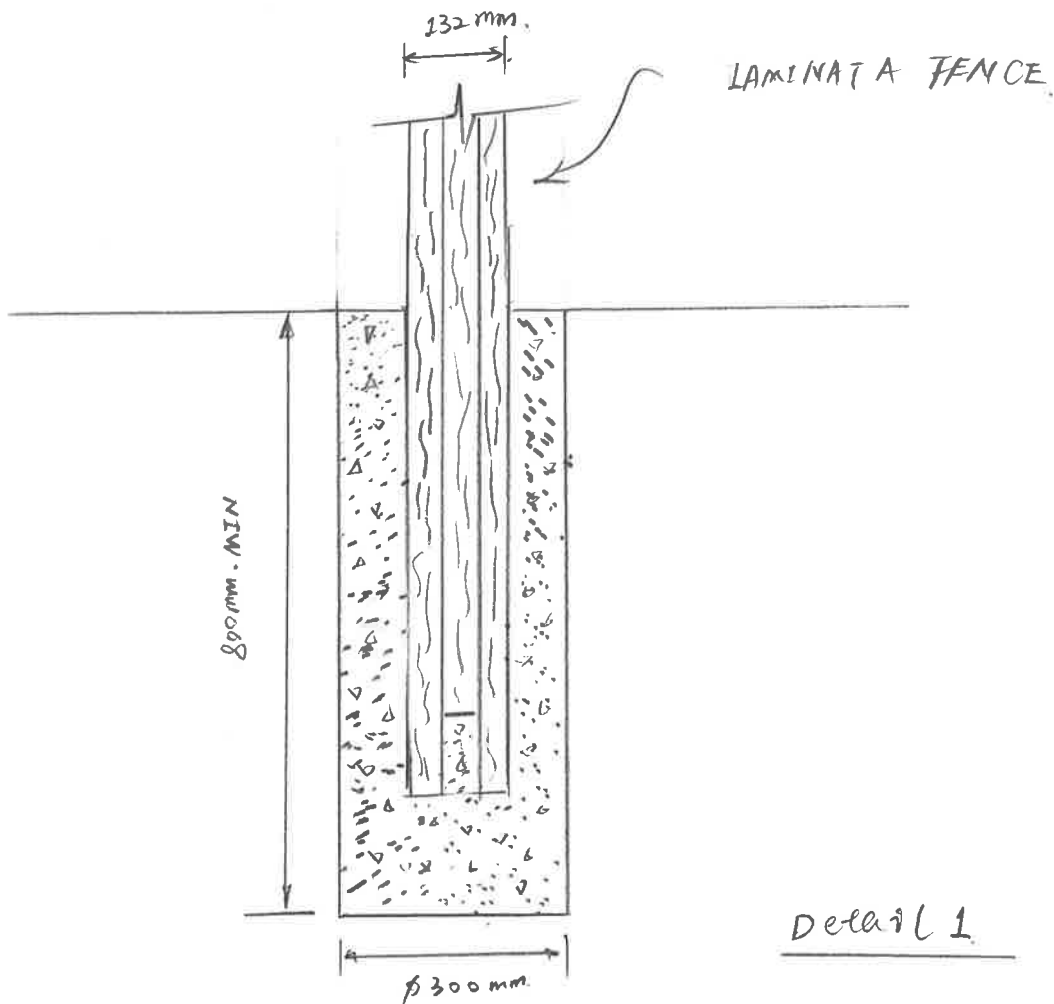
Pole 16 mm

EMBEDMENT : By Rutledge

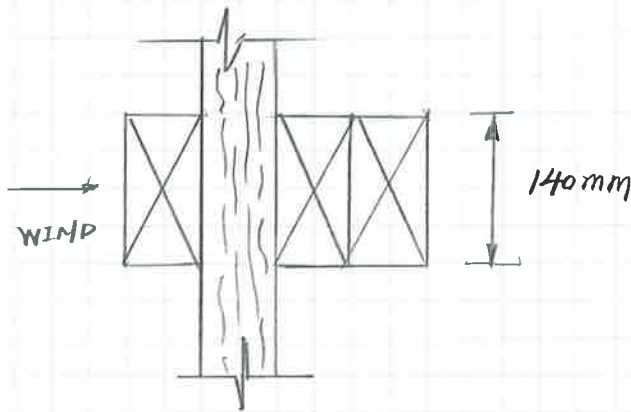
Safe lateral bearing capacity of soil = 100 kpa

Minimum depth of embedment

No restraint at grd surface = 0.8 m
 Full restraint = 0.7 m



CASE B



$$\begin{aligned} \text{Area, } A &= (140 \text{ mm})(45 \text{ mm} + 45 \text{ mm} + 42 \text{ mm} + 45 \text{ mm}) \\ &= 24780 \text{ mm}^2 \end{aligned}$$

Elastic Modulus, Z

$$\begin{aligned} Z &= \frac{(140 \text{ mm})(177 \text{ mm})^2}{6} \\ &= 731010 \text{ mm}^3 \end{aligned}$$

second modulus of inertia, I

$$\begin{aligned} I &= \frac{(140 \text{ mm})(177 \text{ mm})^3}{12} \\ &= 6.47 \times 10^7 \text{ mm}^4 \end{aligned}$$

$$w = \frac{(16 \text{ mm})(8 \times 7.5 \text{ GPa})(6.47 \times 10^7 \text{ mm}^4)}{(2 \text{ m})^4}$$

$$= 3.88 \text{ kN/m}$$

$$t_w = 1.68 \text{ m}$$

$$q = \frac{3.88 \text{ kN/m}}{1.68 \text{ m}}$$

$$= 2.3 \text{ kPa}$$

$$q = 1.2 \left(\frac{0.6 V_b^2}{1000} \right)$$

$$\Rightarrow V_b = 56.5 \text{ m/s.}$$

$$V_{max} = 56.5 \text{ m/s} / 0.83$$

$$= 68 \text{ m/s} \Rightarrow 245 \text{ km/h.}$$

check for strength

$$W = 3.88 \text{ kN/m.}$$

$$M^* = \frac{(3.88 \text{ kN/m}) (2 \text{ m})^2}{2}$$

$$= 7.76 \text{ kNm}$$

capacity

$$\phi M = \phi k f_b z$$

$$= 0.8 \times 1.0 \times 1.0 \times 1.0 \times 14 \text{ MPa} \times 731010 \text{ mm}^3$$

$$= 8.2 \text{ kNm}$$

CHECK TOP HOLDER

$$W = (2.3 \text{ kPa}) (0.28 \text{ m})$$

$$= 0.644 \text{ kN/m}$$

analysis is shown on page 8

\Rightarrow OK

the foundation is calculated and designed in page 9

\Rightarrow USE $\phi 400 \text{ mm}$ with 1100 mm Em bedment
CONCRETE CORE

P K ENGINEERING

STRUCTURAL & GEOTECHNICAL ENGINEERS

TIMBER BEAM DESIGN

Job: 18-130
Ref: TOP HOLDER -CASE B

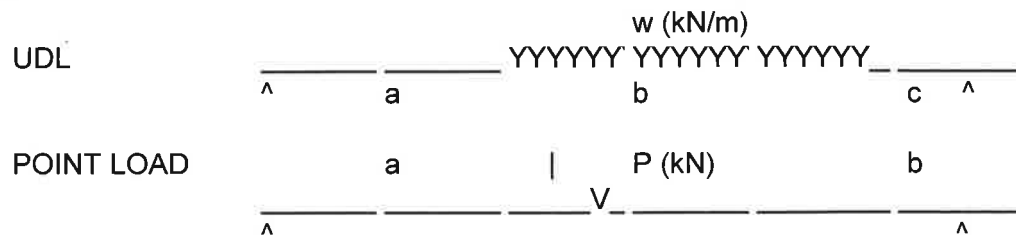
Date: 24MAY18
Designer: A.T.

Total span = 1.68 m Depth = 42 mm
Lay = 1.68 m Breadth = 280 mm

| | | | |
|--------------------|----------------------------------|------------------|-------------|
| K factors | | Stability | |
| Load durat'n K1 | 0.80 | D / B = | 0.15 |
| P'll'l supp't K4 | 1.00 | Lay/B = | 6 |
| Grid system K5 | 1.00 | thus S = | 0 |
| Lam. thick's K27 | 1.00 | and K8 = | 1.00 |
| K factors = | K1 x K4 x K5 x K8 x K27 = | | 0.80 |

| | | | |
|----------------------------|----------|---------------------------|--------------------------|
| Material Properties | | Section Properties | |
| F'b = | 11.2 MPa | area = | 11760 mm ² |
| F's = | 1.5 MPa | Z = | 8.2E+004 mm ³ |
| E = | 7500 MPa | I = | 1.7E+006 mm ⁴ |

LOADS



Moments & deflections at X = 0.84 (m)

| Ref. No. | a (m) | b (m) | loads (m) | Defl'n Factor | Ra (kN) | Rb (kN) | Xmax (m) | Mmax (kNm) | Moment at test x (kNm) | Defl'n at test x (mm) |
|----------|-------|-------|-----------|---------------|---------|---------|----------|------------|------------------------|-----------------------|
|----------|-------|-------|-----------|---------------|---------|---------|----------|------------|------------------------|-----------------------|

| UDL LOADS | | | w (kN/m) | | | | | | | |
|-----------|---|------|----------|---|------|------|------|------|------|-----|
| 1 | 0 | 1.68 | 0.64 | 1 | 0.54 | 0.54 | 0.84 | 0.23 | 0.23 | 5.2 |
| 2 | 0 | 1.68 | 0.00 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |
| 3 | 0 | 1 | 0.00 | 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |

| PT LOADS | | P (kN) | | | | | | | | |
|----------|------|--------|------|-----|------|------|------|------|------|-----|
| 4 | 0.84 | 0.84 | 0.00 | 2 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.0 |
| 5 | 0.84 | 0.84 | 0.00 | 1 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.0 |
| 6 | 0 | 1.68 | 0.00 | 1.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |
| 7 | 0 | 1.68 | 0.00 | 1.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 |

| Totals | | | | | | | | | | |
|--------|--|--|------|------|------|------|-------|--|--|-----|
| | | | 0.54 | 0.54 | 2.52 | 0.23 | 0.227 | | | 5.2 |

STRESS

Max. stress: fb = 2.8 MPa OK
Allowable stress: Fb = Fb = K x F'b = 9.0 MPa

DEFLECTION

Max. deflection = 5.2 mm OK
Limit = 0.004 x span = 6.7 mm

POLE1

P.K.ENGINEERING LIMITED

22-Aug-18

CANTILEVER POLE DESIGN

REF : LAMINATA CASE-B

DESIGNER : A.T.

INPUT DATA :

Height H(m) 2.00
 Pole Dia. d(mm) 175
 Encasement B(mm) 400

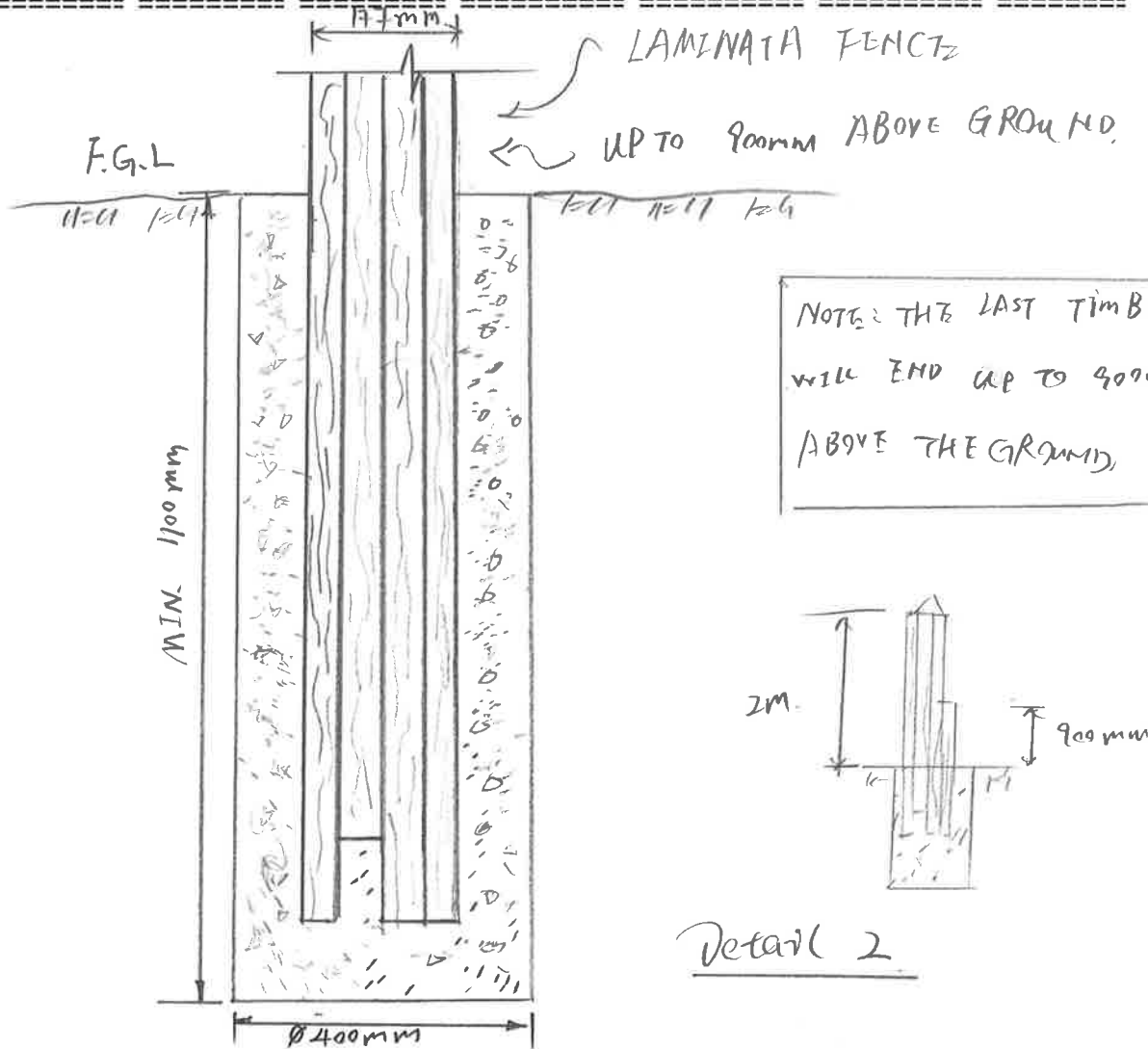
DESIGN :

Total lateral force Ptot = 7.76 kN
 Max. pole moment Mp 7.76 kN-m

STRESSES :
 Pole Fb = Actual 14.74 Mpa Allowable 21.7 Mpa OK

DEFLECTION;
 Pole 16 mm

EMBEDMENT : By Rutledge
 Safe lateral bearing capacity of soil = 100 kpa
 Minimum depth of embedment
 No restraint at grd surface = 1.1 m
 Full restraint = 0.9 m



Detail 2