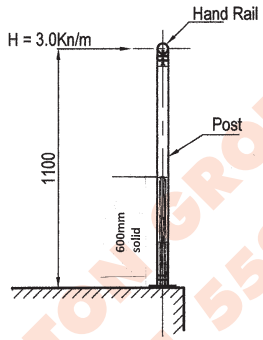
Balustrade System to 3.0kN/m

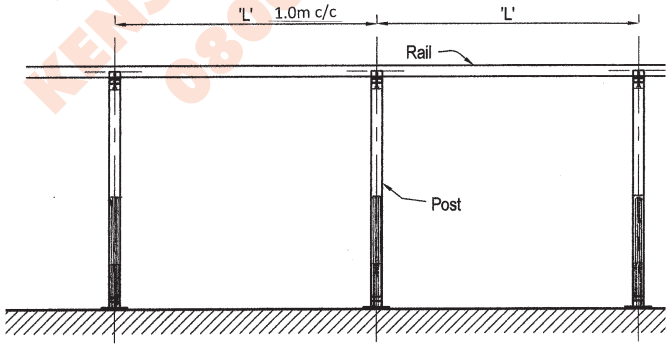
60.3 x 3.9mm stainless tube

Do not risk your professional indemnity - use appropriate materials

BALUSTRADING DESIGN



SECTION



ELEVATION

60.3CHS x 3.9 + 600mm high solid 50mm dia. Spiggot

HANDRAIL & POST DESIGN

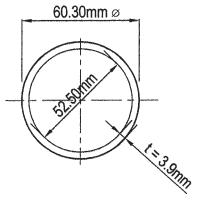
MATERIAL - stainless steel grade 1.4401 (316) [$p_y = 220\ N/mm^2$]

Horizontal load 'H' applied at 1.10m above base plate level.

H= 3.00Kn/m

$\gamma_f = 1.60$

HANDRAIL



$I_{x-x} = \frac{\pi(60.3^4 - 52.5^4)}{64} = 276114.86mm^4$

$Z_{x-x} = \frac{\pi(60.3^4 - 52.5^4)}{32 \times 60.3} = 9158.04mm^3$

$S_{x-x} = 0.167[60.3^3 - (60.3 - 2x3.9)^3] = 12450.37mm^3$

$\epsilon = 1.22$ $D/t = 15.46 = (13.73\epsilon^2)$ section is Class1 - plastic

0.2% proof stress $p_y = 220\ N/mm^2$

Factored lateral load applied to handrail = 3.0 x 1.6 = 4.80Kn/m

L = centres of posts

Applied $M = \frac{4.80 \times L^2}{8} = 0.60\ L^2$ Knm

Allowable $M_c = \frac{220 \times 12450.37}{10^6} = 2.74$ Knm

or

$M_c = \frac{1.2 \times 220 \times 9158.04}{10^6} = 2.42$ Knm

$0.60\ L^2 = 2.42$

$\therefore\ L = \sqrt{\frac{2.42}{0.60}} = 2.01m$

Deflection

Limiting deflection to 25mm

$L = \sqrt[4]{\frac{25 \times 384 \times 200 \times 10^3 \times 276114.86}{5 \times 3.00 \times 10^{12}}} = 2.44m$

MAXIMUM ALLOWABLE SPAN 2.0m

KENSINGTON GROUP
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Email:sales@spiral-staircases.co.uk

HANDRAIL & POST DESIGN

(60.3 x 3.9CHS post with 50mm dia solid Spiggot 600mm high)

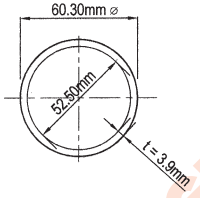
MATERIAL - stainless steel grade 1.4401 (316) [$p_y = 220\ N/mm^2$]

Horizontal load 'H' applied at 1.10m above base plate level.

H= 3.00Kn/m

$\gamma_f = 1.60$

POST



$I_{x-x} = \frac{\pi(60.3^4 - 52.5^4)}{64} = 276114.86mm^4$

$Z_{x-x} = \frac{\pi(60.3^4 - 52.5^4)}{32 \times 60.3} = 9158.04mm^3$

$S_{x-x} = 0.167[60.3^3 - (60.3 - 2x3.9)^3] = 12450.37mm^3$

$\epsilon = 1.22$ $D/t = 15.46 = (10.39\epsilon^2)$ section is Class1 - plastic

0.2% proof stress $p_y = 220\ N/mm^2$

L = centres of posts

Allowable $M_c = \frac{220 \times 12450.37}{10^6} = 2.74$ Knm

or

$M_c = \frac{1.2 \times 220 \times 9158.04}{10^6} = 2.42$ Knm

Aplied moment 500mm below handrail

$M = 4.8 \times L \times 0.5 = 2.40\ L$ Knm

$L = \frac{2.42}{2.40} = 1.01m$

deflection for post at 1.00m c/c

$\delta = \frac{3.0 \times 1.0 \times 10^3 \times 0.5^3 \times 10^9}{3 \times 200 \times 10^3 \times 279114.86} = 2.24mm$ ∴ satisfactory

Balustrade System to 3.0kN/m

60.3 x 3.9mm stainless tube

HANDRAIL & POST DESIGN

(60.3 x 3.9CHS post with 50mm dia solid Spiggot 600mm high)

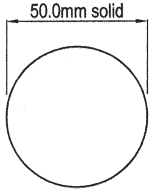
MATERIAL - stainless steel grade 1.4401 (316) [$p_y = 220\ N/mm^2$]

Horizontal load 'H' applied at 1.10m above base plate level.

H= 3.00Kn/m

$\gamma_f = 1.60$

SPIGGOT



$I_{x-x} = \frac{\pi 50^4}{64} = 306835.94mm^4$

$Z_{x-x} = \frac{\pi 50^3}{32} = 12273.44mm^3$

say $S_{x-x} = 1.7 \times 12273.44 = 20864.85mm^3$

0.2 % proof stress $p_y = 220\ N/mm^2$

L = centres of posts

Allowable $M_c = \frac{220 \times 20864.85}{10^6} = 4.59$ Knm

or

$M_c = \frac{1.2 \times 220 \times 12273.44}{10^6} = 3.24$ Knm

at 500mm below handrail

load resisted by post - W_1 load resisted by spiggot - W_2

$\therefore W_1 + W_2 = \frac{(3.0 \times 1.0)\ 1.1}{0.6} = 5.50$ Kn

and

$\frac{W_1}{276114.86} = \frac{W_2}{306835.94}$

$\therefore W_1 = 2.61$ Kn & $W_2 = 2.89$ Kn

Applied moment to post = 2.61 x 0.6 x 1.6 = 2.51 Knm

Applied moment to spiggot = 2.89 x 0.6 x 1.6 = 2.77 Knm

deflection for post at 1.00m c/c

$\delta = \frac{2.61 \times 10^3 \times 0.6^3 \times 10^9}{3 \times 200 \times 10^3 \times 279114.86} = 3.37mm$ ∴ satisfactory

relative deflection at top of post $\delta = \frac{1.42 \times 10^3 \times 1.1^3 \times 10^9}{3 \times 200 \times 10^3 \times 279114.86} = 11.29mm$

PROVIDE 60.3CHS x 3.9 POST WITH 600mm SOLID 50mm dia. SPIGGOT AT 1.00m c/c

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POST BASEPLATE

MATERIAL - stainless steel grade 1.4401

Horizontal load 'H' applied at 1.10m above base plate level.

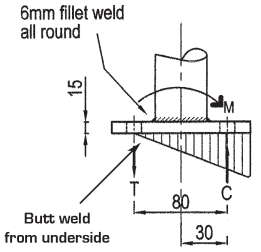
H= 3.0Kn/m (posts at 1.00m c/c)

$\gamma_f = 1.60$

M = 4.80 x 1.0 x 1.1 = 5.28 Knm

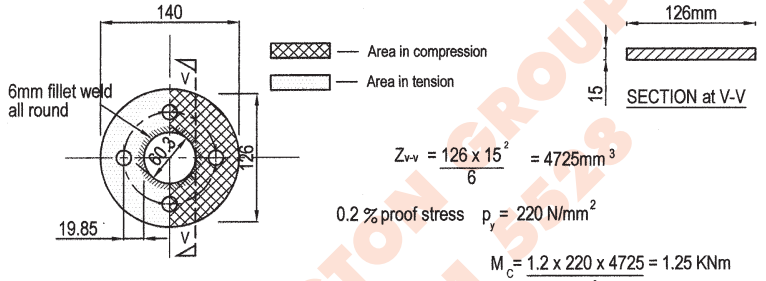
Lever Arm = 80mm

$T = C = \frac{5.28 \times 10^3}{80} = 66.00$ Kn



i) Compression

Assuming rotation due to compression about V-V



$Z_{v-v} = \frac{126 \times 15^2}{6} = 4725mm^3$

0.2 % proof stress $p_y = 220\ N/mm^2$

$M_c = \frac{1.2 \times 220 \times 4725}{10^6} = 1.25$ KNm

Moment in plate due to compression $M = \frac{66.00 \times 0.4(70 - 30.15)\ 10^3}{10^6} = 1.05$ KNm ∴ satisfactory

MAXIMUM ALLOWABLE POST CENTRES 1.00m

i) Tension

0.2 % proof stress $p_y = 220\ N/mm^2$

Moment in plate due to bolt tension $M = \frac{66.00\ (19.85 - 6^{weld})\ 10^3}{10^6} = 0.91$ KNm ∴ satisfactory

MAXIMUM ALLOWABLE POST CENTRES 1.00m