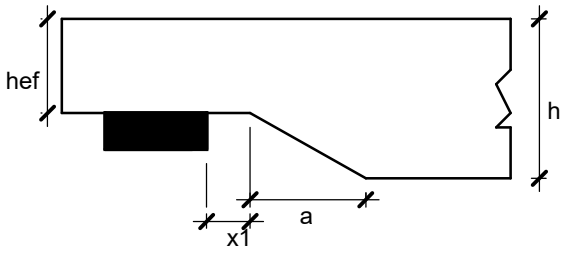
Redstone Consulting Engineers
27 Lowther Street
Whitehaven
Cumbria
CA28 7DN

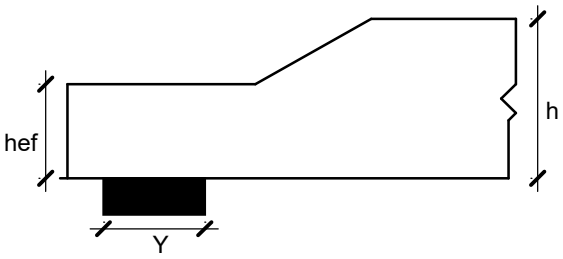
Tel:0194667182

Proj: 2022.98	**Ref :** 1.1 top Rail
Date: 14/07/22	**Page:** 1
Ponsonby Tarn Footbridge General components	

Joist section design



End notch type (a)



End notch type (b)

Calculations for timber joists are in accordance with BS EN 1995-1-1:2004+A1:2008

Timber size		-	47 mm wide x 150 mm deep
Span of joist	SPAN	=	0.6 m
Number of pieces	np	=	1
End bearing - left hand end	Y,l	=	50 mm
- Right hand end	Y,r	=	50 mm
Strength class from Table 1		-	C16
Service class		-	2 (Covered and heated or unheated)
Variable load duration		-	Short term
Load sharing		-	No

Notches details

End notches	- left hand end	- none specified
	- right hand end	- none specified

Design effects

Moment due to permanent load	MEdGd	=	0 kNm
Moment due to variable load	MEdQd	=	0.05 kNm
Shear due to permanent load at left support	VEdGd,L	=	0 kN
Shear due to variable load load at left support	VEdQd,L	=	0.333 kN
Shear due to permanent load at right support	VEdGd,R	=	0 kN
Shear due to variable load load at right support	VEdQd,R	=	0.333 kN
Deflection due to permanent load	U,Gk	=	0 mm
Deflection due to variable load	U,Qk	=	0.0231 mm

Load Description	Type	A	B	C	Gk	Qk
Horizonal load	UDL	0	0.6		0.0	0.74

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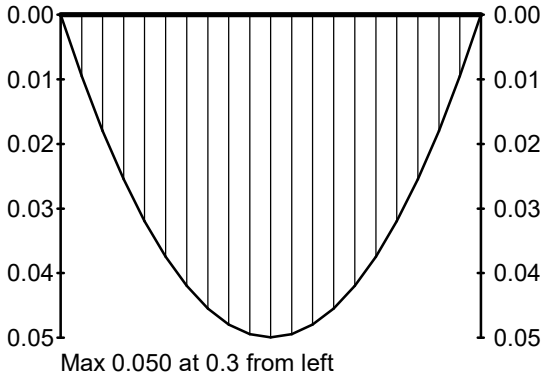
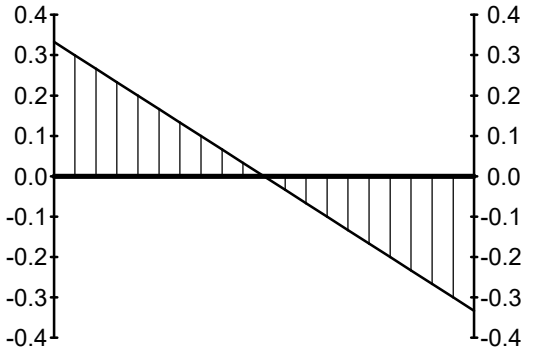
Moment (1.35Gk+1.5Qk) kNm



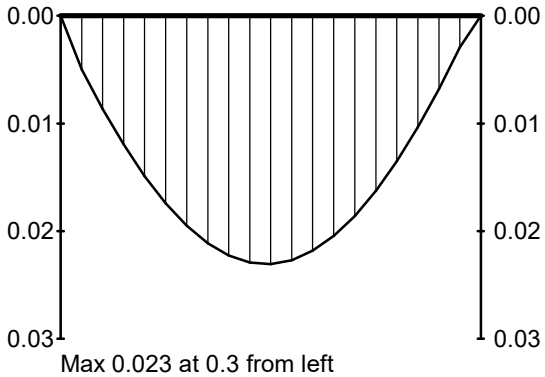
Max 0.050 at 0.3 from left

Shear (1.35Gk+1.5Qk) kN

(0.333) (-0.333)



Deflection (1.0Gk+1.0Qk) mm



Max 0.023 at 0.3 from left

Section properties

Area	A	= 7050 mm^2
Section modulus	Wy	= 176250 mm^3
Second moment of area	Iy	= 13218750 mm^4

Grade stresses - from Table 1 of EN 338:2009

Bending stress	fm,k	= 16 N/mm^2
Tension stress parallel to grain	ft,0,k	= 10 N/mm^2
Tension stress perpendicular to grain	ft,90,k	= 0.4 N/mm^2
Compression stress parallel to grain	fc,0,k	= 17 N/mm^2
Compression stress perpendicular to grain	fc,90,k	= 2.2 N/mm^2
Shear stress	fv,k	= 3.2 N/mm^2
Mean modulus of elasticity parallel	Eomean	= 8 kN/mm^2
5% modulus of elasticity parallel	Eo05	= 5.4 kN/mm^2
Mean shear modulus	Gmean	= 0.5 kN/mm^2
Density	ρk	= 310 kg/m^3

Modification factors

Depth factor	kh	= 1
Load duration factor (Table 3.1)	kmod	= 0.9
Permanent load duration factor (Table 3.1)	kmodp	= 0.6
System length factor (cl 6.6 of EN 1995)	ksys	= 1
Reduced bending stress factor (cl 6.3.3)	kcrit	= 1
Load configuration factor (cl 6.1.5)	kc,90	= 1.5
Shear crack factor (cl 6.1.7)	kcr	= 0.67
Deformation factor (Table 3.2)	kdef	= 0.8

Partial safety factors

Material safety factor	γM	= 1.3

Bending check

Bending Stresses

Bending stress due to permanent load

σmydGd = MEdGd*10^6/Wy
= 0 N/mm^2

Bending stress due to variable load

σmydQd = MEdQd*10^6/Wy
= 0.283 N/mm^2

Total bending stress

σmyd = σmydGd+σmydQd
= 0.283 N/mm^2

Design bending strength

fmd = fmk*kh*kmod*ksys*kcrit/γM
= 11.077 N/mm^2

Bending stress utilisation

Ubm = σmyd/fmd
= 0.0256

Bending status - **PASS.**

Shear check

Left support

Shear stress due to total permanent load

$\tau dGdl = 1.5*(VEdGd,L*10^3)/(kcr*b*hef\_L*np)$

$= 0 \text{ N/mm}^2$

Shear stress due to total variable load

$\tau dQdl = 1.5*(VEdQd,L*10^3)/(kcr*b*hef\_L*np)$

$= 0.106 \text{ N/mm}^2$

Total shear stress

$\tau dl = \tau dGdl+\tau dQdl$

$= 0.106 \text{ N/mm}^2$

Design shear strength

$fvdl = fvk*kmod*ksys*KvL/\gamma M$

$= 2.215 \text{ N/mm}^2$

Shear utilisation

$Ushl = \tau dl/fvdl$

$= 0.0477$

Shear status at left support - **PASS.**

Right support

Shear stress due to total permanent load

$\tau dGdr = 1.5*(VEdGd,R*10^3)/(kcr*b*hef\_R*np)$

$= 0 \text{ N/mm}^2$

Shear stress due to total variable load

$\tau dQdr = 1.5*(VEdQd,R*10^3)/(kcr*b*hef\_R*np)$

$= 0.106 \text{ N/mm}^2$

Total shear stress

$\tau dr = \tau dGdr+\tau dQdr$

$= 0.106 \text{ N/mm}^2$

Design shear strength

$fvdr = fvk*kmod*ksys*KvR/\gamma M$

$= 2.215 \text{ N/mm}^2$

Shear utilisation

$Ushr = \tau dr/fvdr$

$= 0.0477$

Shear status at right support - **PASS.**

Bearing check

Left support bearing check

Bearing contact length

cl = Y,l+minbear
= 80 mm

Bearing stress due to permanent load

σc90dGdl = VEdGd,L*10^3/(b*cl*np)
= 0 N/mm^2

Bearing stress due to variable load

σc90dQdl = VEdQd,L*10^3/(b*cl*np)
= 0.0886 N/mm^2

Total bearing stress

σc90dl = σc90dGdl+σc90dQdl
= 0.0886 N/mm^2

Design bearing strength

fc90dl = fc90k*kmod*ksys*kc,90/γM
= 2.285 N/mm^2

Bearing stress utilisation

Ubl = σc90dl/fc90dl
= 0.0388

Bearing status at left support - **PASS.**

Right support bearing check

Bearing contact length

cl = Y,r+minbear
= 80 mm

Bearing stress due to permanent load

σc90dGdr = VEdGd,R*10^3/(b*cl*np)
= 0 N/mm^2

Bearing stress due to variable load

σc90dQdr = VEdQd,R*10^3/(b*cl*np)
= 0.0886 N/mm^2

Total bearing stress

σc90dr = σc90dGdr+σc90dQdr
= 0.0886 N/mm^2

Design bearing strength

fc90dr = fc90k*kmod*ksys*kc,90/γM
= 2.285 N/mm^2

Bearing stress utilisation

Ubr = σc90dr/fc90dr
= 0.0388

Bearing status at right support - **PASS.**

Deflection check

Section properties used to calculate bending and shear deflection

Second moment of area

I = 1320 mm^4

Modulus of elasticity

Eomean = 8000 N/mm^2

Area

A = 70.5 mm^2

Shear modulus

Gmean = 500 N/mm^2

Section factor

F = 1.2 (For rectangular section)

Final deflection due to permanent load,

UfnG = U,Gk*(1+kdef)
= 0 mm

Final deflection due to variable load,

UfnQ = U,Qk*(1+(kdef*ψ21))
= 0.0286 mm

Total deflection,

	Ufin	= UfnG+UfnQ
		= 0.0286 mm

Allowable deflection,

	Uallow	= SPAN*1000/250
		= 2.4 mm

Deflection utilisation,

	Udef	= Ufin/Uallow
		= 0.0119

Deflection status - **PASS.**

The section 47 x 150 mm PASSES all checks