Barrason's Engineers

ENGINEERING COMPUTATIONS

PROJECT:

Concrete Sleeper Retaining Wall Design

CLIENT:

Ryan Schafler

PROPERTY ADDRESS:

Concrete Sleepers Victoria

Job No:	2005134
Designed:	B.E.
Date:	22-05-2020

CODES OF PRACTICE:

→ B.C.A
→ AS1170.0 – Structural Design Actions: General Principles
→ AS1170.1 – Structural Design Actions: Permanent, Imposed and Other Actions
→ AS1170.2 – Structural Design Actions: Wind Actions
→ AS1684 – Timber Framing
→ AS2870 – Residential Slabs and Footings
→ AS4100 – Steel Structures
→ AS3600 – Concrete Structures

CONCRETE MEMBER V5.02

ramsetreid

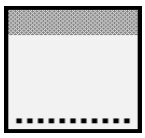
Section:	**(1800x200x100 Concrete Sleeper) 100mm (D) x 200mm (W) beam, f'c=40MPa**	
Reinf't:	**2.0-N12 bottom, ku = 0.34**	
Strength:	**(+ve M) M* = 2.9kNm < øMuo = 5.0kNm**	**OK (0.57)**
Cracking:	**fscr = 186MPa < Fscr = 330MPa & fscr1 = 186MPa < Fscr1 = 400MPa**	**OK (0.47,0.56)**
Ast.min:	**Ast.min = 47mm² < Ast = 226mm² (Minimum of Deemed and actual)**	**OK (0.21)**

Geometry

S.Wt = 0.50 kN/m L/D ratio = 18.0

Concrete strength (f'c) = 40 MPa

Depth (D) = 100 mm
Web width (W) = 200 mm, (S)lab
Flange width (Bf) = 200 mm
Flange thickness (Tf) = 0 mm



Side cover = 30 mm
Concrete weight = 25.0 kN/m³
Fully enclosed = N (Y)es,(N)o
Gross area (Ag) = 20000 mm²

Formwork = S (S)tandard,(R)igid
Exposure top = B2 Tab 4.10.3.2
Exposure bottom = B1 Tab 4.10.3.2
Side = B1 Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	2.9	0.0	kNm
Ms1*	0.0	2.4	0.0	kNm
Ms*	0.0	2.4	0.0	kNm
Ast req'd	0	122	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.1-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	N	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	64	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	64	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	44	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	64	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	6.3	kNm	ku =	0.337	
Design capacity (øMuo) =	5.0	kNm	ø =	0.800	Table 2.2.2
			Ast.min =	47	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	186	MPa	Max. stress (Fscr) =	330	MPa	OK (0.56)
Steel stress (fscr1) =	186	MPa	Max. stress (Fscr1) =	400	MPa	OK (0.47)

Geometry for (1800x200x100 Concrete Sleeper): Concrete simple beam

Description =	100mm (D) x 200mm (W) beam		Ix =	16.66666667	x10⁶ mm⁴
Span (L) =	1800	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	20000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

	Uniform loads (kN/m)			Point loads (kN)			
Uniform loads	**UDL**	**Partial 1**	**Partial 2**	**Point loads**	**PL 1**	**PL 2**	**PL 3**
Dead load (wdl) =	5.44			Dead load (pdl) =			
Live load (wll) =	0.40			Live load (pll) =			
Start from LHS (mm) =	0			Pos. from LHS (mm) =			
End from LHS (mm) =	1800			Ultimate load (p*) =	0.00	0.00	0.00
S.Wt =	0.00	kN/m					
Ultimate load (w*) =	7.13	0.00	0.00	Include S.Wt =	N	(Y)es,(N)o	
				Strength loadcase =	C	(D)ead Only,(C)omb.	
Live Load type =	Permanent	(Concrete)					
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00				
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00				
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00				

Results at midspan (Max +ve M)

Position of result (x) = 900 mm

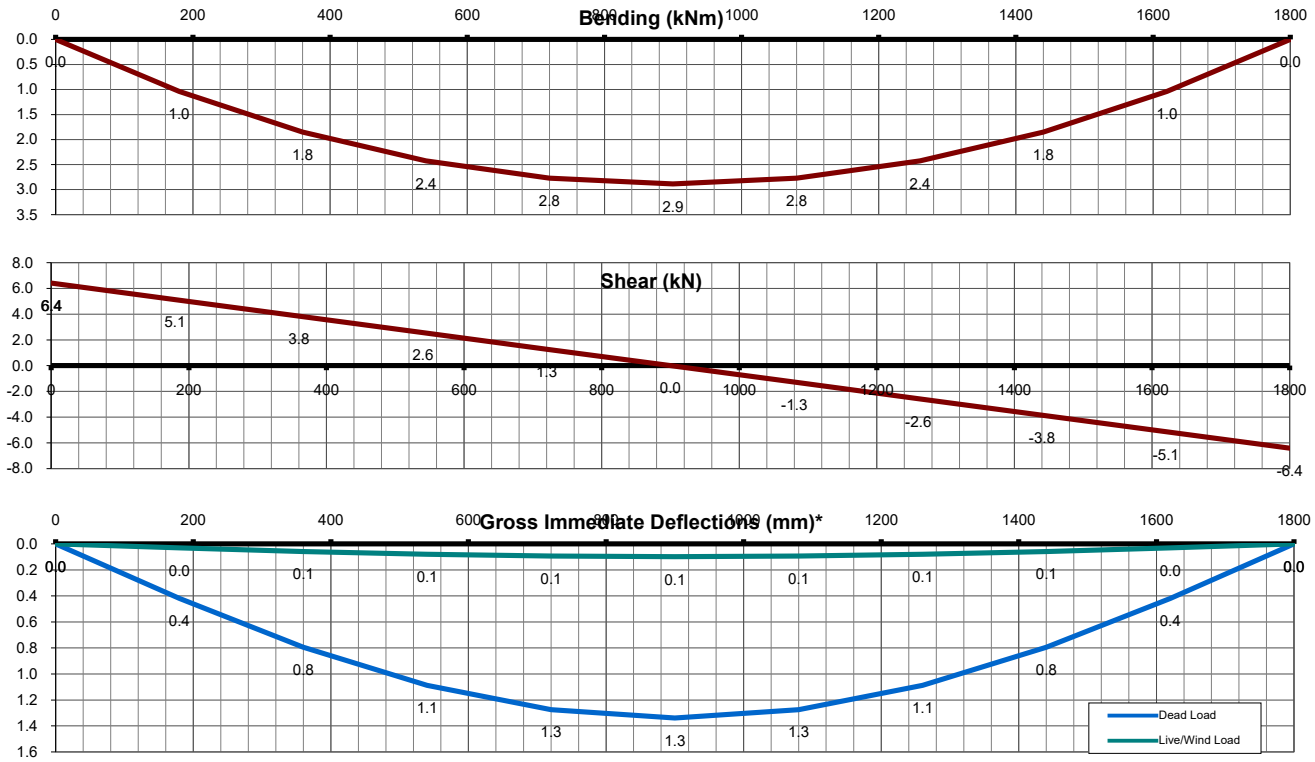
1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	
Rdl	4.90		4.90					kN	
Rll	0.36		0.36					kN	
R*	6.42		6.42					kN	
M*	0.00	2.89	0.00	2.89	900	0.00	0	kNm	
V*	6.42	0.00	-6.42	6.42	0			kN	**Span /**
δdl	0.00	1.34	0.00	1.34	900	0.00	0	mm	1346
δll	0.00	0.10	0.00	0.10	900	0.00	0	mm	18300
δdl+Ψs*δll	0.00	1.44	0.00	1.44	900	0.00	0	mm	1253

δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered



CONCRETE MEMBER V5.02

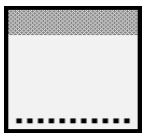
ramsetreid

Section: **(1800x200x80 Concrete Sleeper) 80mm (D) x 200mm (W) beam, f'c=40MPa**
Reinf't: **2.0-N12 bottom, ku = 0.49 > 0.36 - Non ductile**
Strength: **(+ve M) M* = 1.8kNm < øMuo = 2.7kNm** **OK (0.68)**
Cracking: **fscr = 170MPa < Fscr = 330MPa & fscr1 = 170MPa < Fscr1 = 400MPa** **OK (0.43,0.52)**
Ast.min: **Ast.min = 44mm² < Ast = 226mm² (Minimum of Deemed and actual)** **OK (0.20)**

Geometry

S.Wt = 0.40 kN/m L/D ratio = 22.5

Concrete strength (f'c) =	40	MPa
Depth (D) =	80	mm
Web width (W) =	200	mm, (S)lab
Flange width (Bf) =	200	mm
Flange thickness (Tf) =	0	mm



Comp.
Tension

Side cover =	30	mm	Formwork =	S	(S)tandard,(R)igid
Concrete weight =	25.0	kN/m³	Exposure top =	B2	Tab 4.10.3.2
Fully enclosed =	N	(Y)es,(N)o	Exposure bottom =	B1	Tab 4.10.3.2
Gross area (Ag) =	16000	mm²	Side =	B1	Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	1.8	0.0	kNm
Ms1*	0.0	1.5	0.0	kNm
Ms*	0.0	1.5	0.0	kNm
Ast req'd	0	114	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.0-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	44	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	44	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	24	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	44	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	4.0	kNm	ku =	0.491	Warning - ku > 0.36 - Cl 8.1.5
Design capacity (øMuo) =	2.7	kNm	ø =	0.658	Table 2.2.2
			Ast.min =	44	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	170	MPa	Max. stress (Fscr) =	330	MPa OK (0.52)
Steel stress (fscr1) =	170	MPa	Max. stress (Fscr1) =	400	MPa OK (0.43)

Geometry for (1800x200x80 Concrete Sleeper): Concrete simple beam

Description =	80mm (D) x 200mm (W) beam		Ix =	8.533333333	x10⁶ mm⁴
Span (L) =	1800	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	16000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

	Uniform loads (kN/m)			Point loads (kN)			
Uniform loads	**UDL**	**Partial 1**	**Partial 2**	**Point loads**	**PL 1**	**PL 2**	**PL 3**
Dead load (wdl) =	3.20			Dead load (pdl) =			
Live load (wll) =	0.40			Live load (pll) =			
Start from LHS (mm) =	0			Pos. from LHS (mm) =			
End from LHS (mm) =	1800			Ultimate load (p*) =	0.00	0.00	0.00
S.Wt =	0.00	kN/m					
Ultimate load (w*) =	4.44	0.00	0.00	Include S.Wt =	N	(Y)es,(N)o	
				Strength loadcase =	C	(D)ead Only,(C)omb.	
Live Load type =	Permanent	(Concrete)					
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00				
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00				
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00				

Results at midspan (Max +ve M)

Position of result (x) = 900 mm

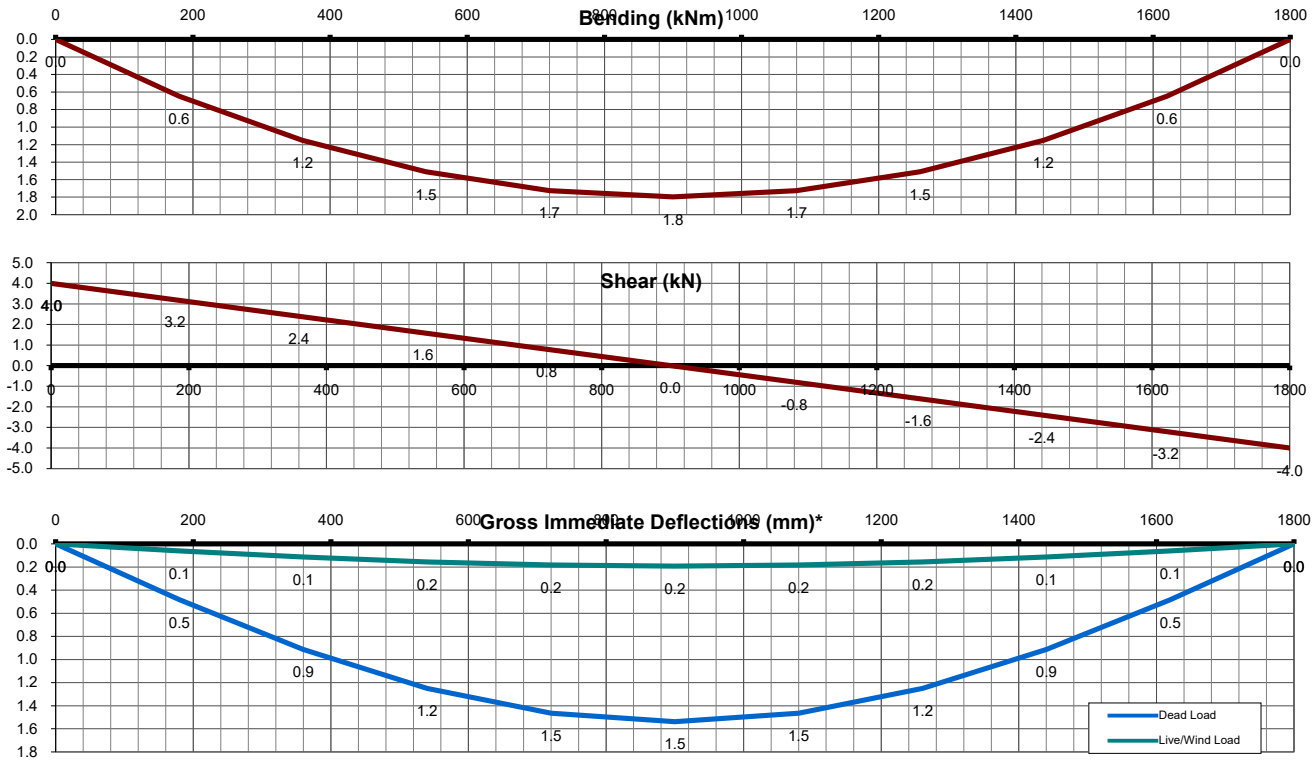
1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	
Rdl	2.88		2.88					kN	
Rll	0.36		0.36					kN	
R*	4.00		4.00					kN	
M*	0.00	1.80	0.00	1.80	900	0.00	0	kNm	
V*	4.00	0.00	-4.00	4.00	0			kN	Span /
δdl	0.00	1.54	0.00	1.54	900	0.00	0	mm	1171
δll	0.00	0.19	0.00	0.19	900	0.00	0	mm	9369
δdl+Ψs*δll	0.00	1.73	0.00	1.73	900	0.00	0	mm	1041

δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered



CONCRETE MEMBER V5.02

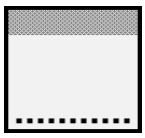
ramsetreid

Section: **(2000x200x100 Concrete Sleeper) 100mm (D) x 200mm (W) beam, f'c=40MPa**
Reinf't: **2.0-N12 bottom, ku = 0.34**
Strength: **(+ve M) M* = 3.2kNm < øMuo = 5.0kNm** **OK (0.63)**
Cracking: **fscr = 205MPa < Fscr = 330MPa & fscr1 = 205MPa < Fscr1 = 400MPa** **OK (0.51,0.62)**
Ast.min: **Ast.min = 47mm² < Ast = 226mm² (Minimum of Deemed and actual)** **OK (0.21)**

Geometry

S.Wt = 0.50 kN/m L/D ratio = 20.0

Concrete strength (f'c) =	40	MPa
Depth (D) =	100	mm
Web width (W) =	200	mm, (S)lab
Flange width (Bf) =	200	mm
Flange thickness (Tf) =	0	mm



Comp.
Tension

Side cover =	30	mm	Formwork =	S	(S)tandard,(R)igid
Concrete weight =	25.0	kN/m³	Exposure top =	B2	Tab 4.10.3.2
Fully enclosed =	N	(Y)es,(N)o	Exposure bottom =	B1	Tab 4.10.3.2
Gross area (Ag) =	20000	mm²	Side =	B1	Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	3.2	0.0	kNm
Ms1*	0.0	2.6	0.0	kNm
Ms*	0.0	2.6	0.0	kNm
Ast req'd	0	135	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.2-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	64	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	64	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	44	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	64	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	6.3	kNm	ku =	0.337	
Design capacity (øMuo) =	5.0	kNm	ø =	0.800	Table 2.2.2
			Ast.min =	47	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	205	MPa	Max. stress (Fscr) =	330	MPa	OK (0.62)
Steel stress (fscr1) =	205	MPa	Max. stress (Fscr1) =	400	MPa	OK (0.51)

2000x200x100 Concrete Sleeper (Ana)

ANALYSIS V5.02 ramsetreid

Geometry for (2000x200x100 Concrete Sleeper (Ana)): Concrete simple beam

Description =	100mm (D) x 200mm (W) beam		Ix =	16.66666667	x10⁶ mm⁴
Span (L) =	2000	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	20000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

	Uniform loads (kN/m)			Point loads (kN)			
Uniform loads	**UDL**	**Partial 1**	**Partial 2**	**Point loads**	**PL 1**	**PL 2**	**PL 3**
Dead load (wdl) =	4.80			Dead load (pdl) =			
Live load (wll) =	0.40			Live load (pll) =			
Start from LHS (mm) =	0			Pos. from LHS (mm) =			
End from LHS (mm) =	2000			Ultimate load (p*) =	0.00	0.00	0.00
S.Wt =	0.00	kN/m					
Ultimate load (w*) =	6.36	0.00	0.00	Include S.Wt =	N	(Y)es,(N)o	
				Strength loadcase =	C	(D)ead Only,(C)omb.	
Live Load type =	Permanent	(Concrete)					
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00				
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00				
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00				

Results at midspan (Max +ve M)

Position of result (x) = 1000 mm

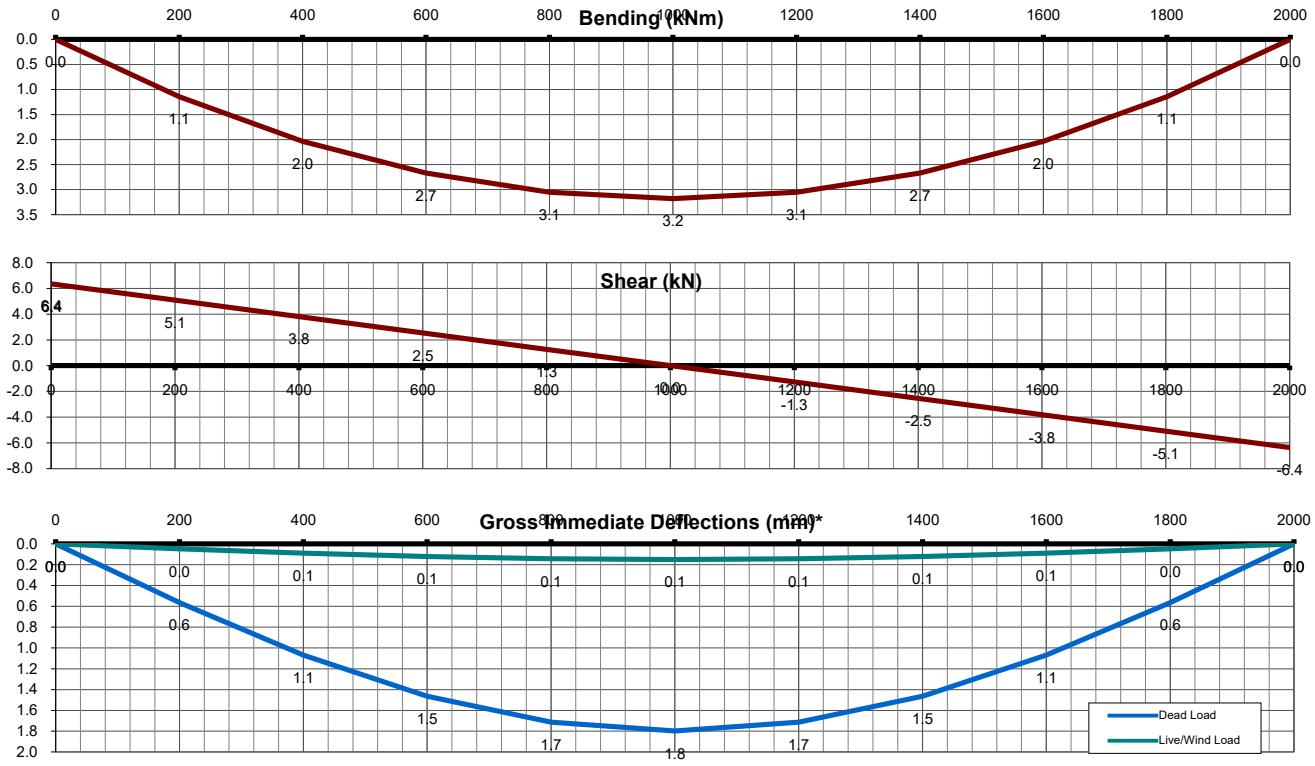
1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	
Rdl	4.80		4.80					kN	
Rll	0.40		0.40					kN	
R*	6.36		6.36					kN	
M*	0.00	3.18	0.00	3.18	1000	0.00	0	kNm	
V*	6.36	0.00	-6.36	6.36	0			kN	**Span /**
δdl	0.00	1.80	0.00	1.80	1000	0.00	0	mm	1112
δll	0.00	0.15	0.00	0.15	1000	0.00	0	mm	13340
δdl+Ψs*δll	0.00	1.95	0.00	1.95	1000	0.00	0	mm	1026

δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered



CONCRETE MEMBER V5.02

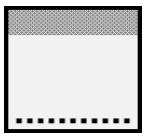
ramsetreid

Section: (2000x200x80 Concrete Sleeper) 80mm (D) x 200mm (W) beam, f'c=40MPa
Reinf't: 2.0-N12 bottom, ku = 0.49 > 0.36 - Non ductile
Strength: (+ve M) M* = 2.0kNm < øMuo = 2.7kNm — **OK (0.76)**
Cracking: fscr = 192MPa < Fscr = 330MPa & fscr1 = 192MPa < Fscr1 = 400MPa — **OK (0.48,0.58)**
Ast.min: Ast.min = 44mm² < Ast = 226mm² (Minimum of Deemed and actual) — **OK (0.20)**

Geometry

S.Wt = 0.40 kN/m — L/D ratio = 25.0

Concrete strength (f'c) =	40	MPa
Depth (D) =	80	mm
Web width (W) =	200	mm, (S)lab
Flange width (Bf) =	200	mm
Flange thickness (Tf) =	0	mm



Side cover =	30	mm	Formwork =	S	(S)tandard,(R)igid
Concrete weight =	25.0	kN/m³	Exposure top =	B2	Tab 4.10.3.2
Fully enclosed =	N	(Y)es,(N)o	Exposure bottom =	B1	Tab 4.10.3.2
Gross area (Ag) =	16000	mm²	Side =	B1	Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	2.0	0.0	kNm
Ms1*	0.0	1.6	0.0	kNm
Ms*	0.0	1.6	0.0	kNm
Ast req'd	0	130	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.2-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	44	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	44	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	24	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	44	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	4.0	kNm	ku =	0.491	Warning - ku > 0.36 - Cl 8.1.5
Design capacity (øMuo) =	2.7	kNm	ø =	0.658	Table 2.2.2
			Ast.min =	44	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	192	MPa	Max. stress (Fscr) =	330	MPa — OK (0.58)
Steel stress (fscr1) =	192	MPa	Max. stress (Fscr1) =	400	MPa — OK (0.48)

2000x200x80 Concrete Sleeper

ANALYSIS V5.02 ramsetreid

Geometry for (2000x200x80 Concrete Sleeper): Concrete simple beam

Description =	80mm (D) x 200mm (W) beam		Ix =	8.533333333	x10⁶ mm⁴
Span (L) =	2000	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	16000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

Uniform loads (kN/m)

Uniform loads	UDL	Partial 1	Partial 2
Dead load (wdl) =	2.88		
Live load (wll) =	0.40		
Start from LHS (mm) =	0		
End from LHS (mm) =	2000		
S.Wt =	0.00	kN/m	
Ultimate load (w*) =	4.06	0.00	0.00

Point loads (kN)

Point loads	PL 1	PL 2	PL 3
Dead load (pdl) =			
Live load (pll) =			
Pos. from LHS (mm) =			
Ultimate load (p*) =	0.00	0.00	0.00

Include S.Wt =	N	(Y)es,(N)o			
Strength loadcase =	C	(D)ead Only,(C)omb.			
Live Load type =	Permanent	(Concrete)			
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00		
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00		
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00		
Position of result (x) =	1000	mm			

Results at midspan (Max +ve M)

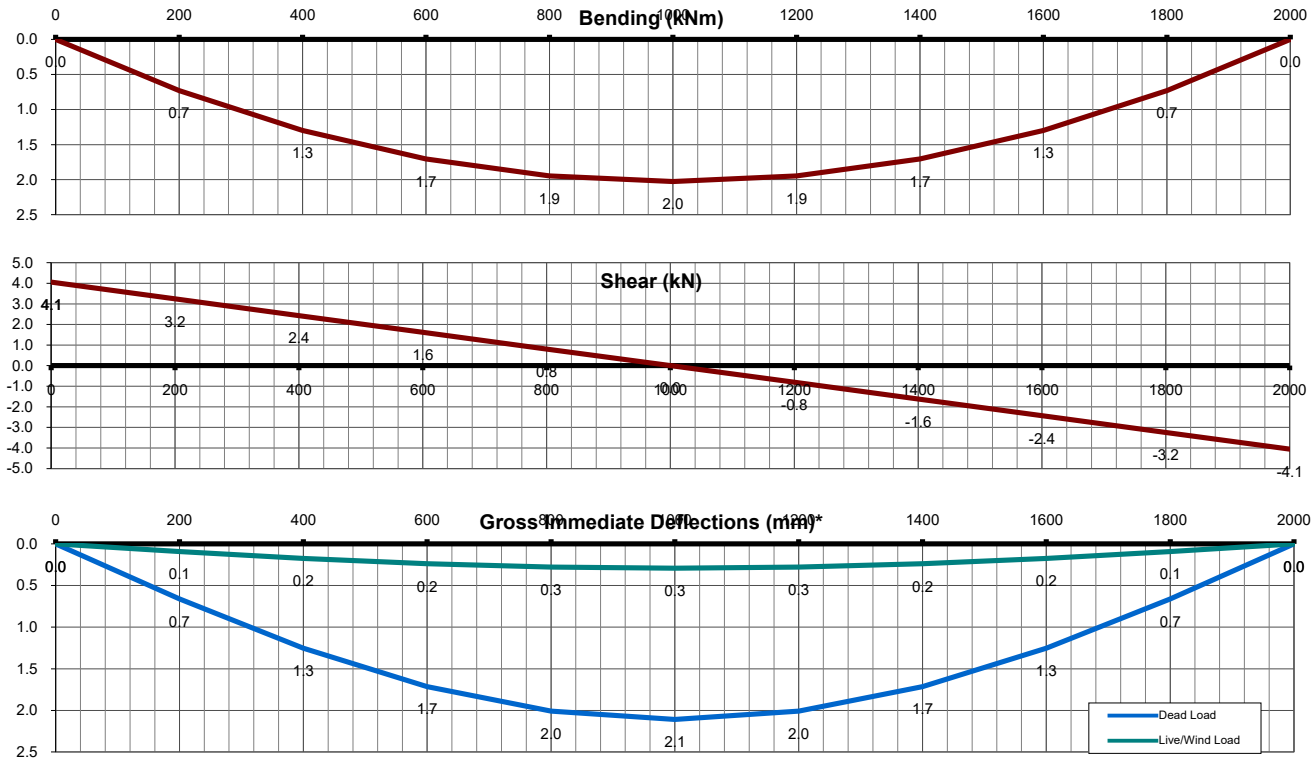
1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	
Rdl	2.88		2.88					kN	
Rll	0.40		0.40					kN	
R*	4.06		4.06					kN	
M*	0.00	2.03	0.00	2.03	1000	0.00	0	kNm	
V*	4.06	0.00	-4.06	4.06	0			kN	Span /
δdl	0.00	2.11	0.00	2.11	1000	0.00	0	mm	949
δll	0.00	0.29	0.00	0.29	1000	0.00	0	mm	6830
δdl+Ψs*δll	0.00	2.40	0.00	2.40	1000	0.00	0	mm	833

δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered



CONCRETE MEMBER V5.02

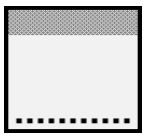
ramsetreid

Section:	**(2400x200x100 Concrete Sleeper) 100mm (D) x 200mm (W) beam, f'c=40MPa**	
Reinf't:	**2.0-N12 bottom, ku = 0.34**	
Strength:	**(+ve M) M* = 4.0kNm < øMuo = 5.0kNm**	**OK (0.80)**
Cracking:	**fscr = 258MPa < Fscr = 330MPa & fscr1 = 258MPa < Fscr1 = 400MPa**	**OK (0.65,0.78)**
Ast.min:	**Ast.min = 47mm² < Ast = 226mm² (Minimum of Deemed and actual)**	**OK (0.21)**

Geometry

S.Wt = 0.50 kN/m L/D ratio = 24.0

Concrete strength (f'c) =	40	MPa
Depth (D) =	100	mm
Web width (W) =	200	mm, (S)lab
Flange width (Bf) =	200	mm
Flange thickness (Tf) =	0	mm



Side cover =	30	mm	Formwork =	S	(S)tandard,(R)igid
Concrete weight =	25.0	kN/m³	Exposure top =	B2	Tab 4.10.3.2
Fully enclosed =	N	(Y)es,(N)o	Exposure bottom =	B1	Tab 4.10.3.2
Gross area (Ag) =	20000	mm²	Side =	B1	Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	4.0	0.0	kNm
Ms1*	0.0	3.3	0.0	kNm
Ms*	0.0	3.3	0.0	kNm
Ast req'd	0	176	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.6-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	64	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	64	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	44	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	64	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	6.3	kNm	ku =	0.337	
Design capacity (øMuo) =	5.0	kNm	ø =	0.800	Table 2.2.2
			Ast.min =	47	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	258	MPa	Max. stress (Fscr) =	330	MPa	OK (0.78)
Steel stress (fscr1) =	258	MPa	Max. stress (Fscr1) =	400	MPa	OK (0.65)

2400x200x100 Concrete Sleeper (Ana)

ANALYSIS V5.02 ramsetreid

Geometry for (2400x200x100 Concrete Sleeper (Ana)): Concrete simple beam

Description =	100mm (D) x 200mm (W) beam		Ix =	16.66666667	x10⁶ mm⁴
Span (L) =	2400	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	20000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

Uniform loads (kN/m)				Point loads (kN)			
Uniform loads	**UDL**	**Partial 1**	**Partial 2**	**Point loads**	**PL 1**	**PL 2**	**PL 3**
Dead load (wdl) =	4.16			Dead load (pdl) =			
Live load (wll) =	0.40			Live load (pll) =			
Start from LHS (mm) =	0			Pos. from LHS (mm) =			
End from LHS (mm) =	2400			Ultimate load (p*) =	0.00	0.00	0.00
S.Wt =	0.00	kN/m					
Ultimate load (w*) =	5.59	0.00	0.00	Include S.Wt =	N	(Y)es,(N)o	
				Strength loadcase =	C	(D)ead Only,(C)omb.	
Live Load type =	Permanent	(Concrete)					
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00				
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00				
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00				

Results at midspan (Max +ve M)

Position of result (x) = 1200 mm

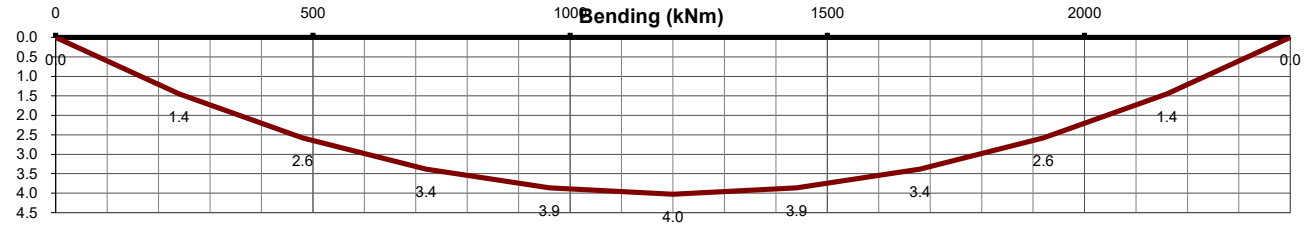
1.20*G+1.50*Q analysed

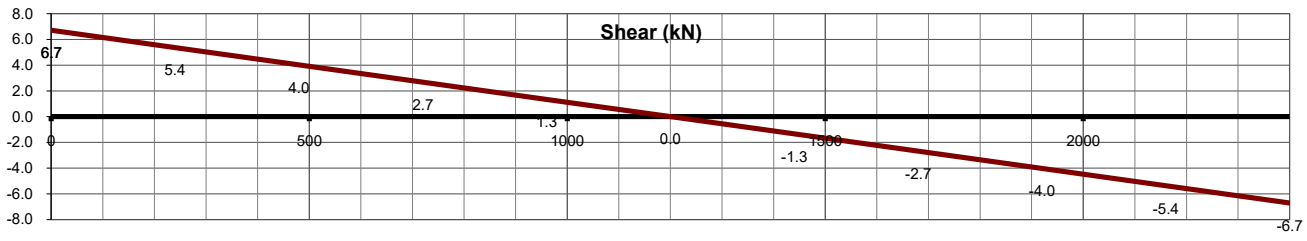
	Left	At x	Right	Max	At	Min	At	Units	
Rdl	4.99		4.99					kN	
Rll	0.48		0.48					kN	
R*	6.71		6.71					kN	
M*	0.00	4.03	0.00	4.03	1200	0.00	0	kNm	
V*	6.71	0.00	-6.71	6.71	0			kN	**Span /**
δdl	0.00	3.23	0.00	3.23	1200	0.00	0	mm	742
δll	0.00	0.31	0.00	0.31	1200	0.00	0	mm	7720
δdl+Ψs*δll	0.00	3.54	0.00	3.54	1200	0.00	0	mm	677

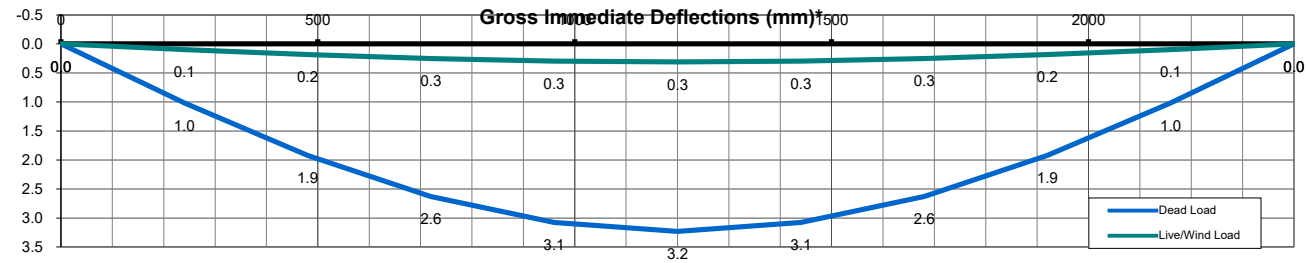
δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered







CONCRETE MEMBER V5.02

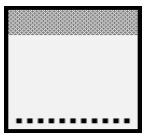
ramsetreid

Section: **(2400x200x80 Concrete Sleeper) 80mm (D) x 200mm (W) beam, f'c=40MPa**
Reinf't: **2.0-N12 bottom, ku = 0.49 > 0.36 - Non ductile**
Strength: **(+ve M) M* = 2.4kNm < øMuo = 2.7kNm** **OK (0.89)**
Cracking: **fscr = 222MPa < Fscr = 330MPa & fscr1 = 222MPa < Fscr1 = 400MPa** **OK (0.56,0.67)**
Ast.min: **Ast.min = 44mm² < Ast = 226mm² (Minimum of Deemed and actual)** **OK (0.20)**

Geometry

S.Wt = 0.40 kN/m L/D ratio = 30.0

Concrete strength (f'c) =	40	MPa
Depth (D) =	80	mm
Web width (W) =	200	mm, (S)lab
Flange width (Bf) =	200	mm
Flange thickness (Tf) =	0	mm



Side cover =	30	mm	Formwork =	S	(S)tandard,(R)igid
Concrete weight =	25.0	kN/m³	Exposure top =	B2	Tab 4.10.3.2
Fully enclosed =	N	(Y)es,(N)o	Exposure bottom =	B1	Tab 4.10.3.2
Gross area (Ag) =	16000	mm²	Side =	B1	Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	2.4	0.0	kNm
Ms1*	0.0	1.9	0.0	kNm
Ms*	0.0	1.9	0.0	kNm
Ast req'd	0	156	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.4-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	44	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	44	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	24	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	44	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	4.0	kNm	ku =	0.491	Warning - ku > 0.36 - Cl 8.1.5
Design capacity (øMuo) =	2.7	kNm	ø =	0.658	Table 2.2.2
			Ast.min =	44	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	222	MPa	Max. stress (Fscr) =	330	MPa	OK (0.67)
Steel stress (fscr1) =	222	MPa	Max. stress (Fscr1) =	400	MPa	OK (0.56)

Geometry for (2400x200x80 Concrete Sleeper): Concrete simple beam

Description =	80mm (D) x 200mm (W) beam		Ix =	8.533333333	x10⁶ mm⁴
Span (L) =	2400	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	16000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

Uniform loads (kN/m)

Uniform loads	UDL	Partial 1	Partial 2
Dead load (wdl) =	2.24		
Live load (wll) =	0.40		
Start from LHS (mm) =	0		
End from LHS (mm) =	2400		
S.Wt =	0.00	kN/m	
Ultimate load (w*) =	3.29	0.00	0.00

Point loads (kN)

Point loads	PL 1	PL 2	PL 3
Dead load (pdl) =			
Live load (pll) =			
Pos. from LHS (mm) =			
Ultimate load (p*) =	0.00	0.00	0.00

Include S.Wt =	N	(Y)es,(N)o
Strength loadcase =	C	(D)ead Only,(C)omb.

Live Load type =	Permanent	(Concrete)		
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00	
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00	
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00	

Results at midspan (Max +ve M)

Position of result (x) = 1200 mm

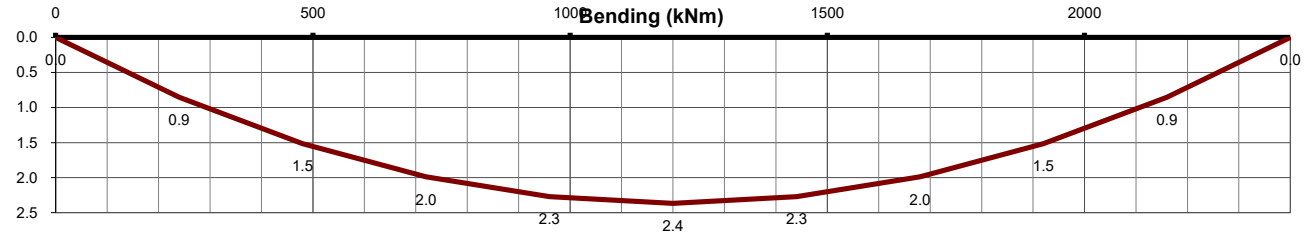
1.20*G+1.50*Q analysed

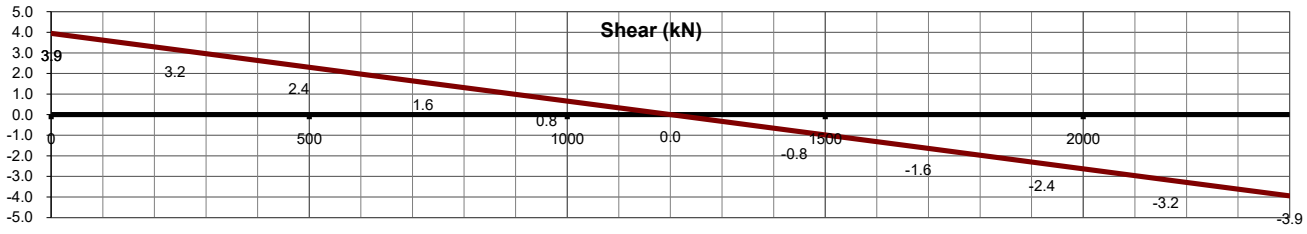
	Left	At x	Right	Max	At	Min	At	Units	
Rdl	2.69		2.69					kN	
Rll	0.48		0.48					kN	
R*	3.95		3.95					kN	
M*	0.00	2.37	0.00	2.37	1200	0.00	0	kNm	
V*	3.95	0.00	-3.95	3.95	0			kN	Span /
δdl	0.00	3.40	0.00	3.40	1200	0.00	0	mm	706
δll	0.00	0.61	0.00	0.61	1200	0.00	0	mm	3953
δdl+Ψs*δll	0.00	4.01	0.00	4.01	1200	0.00	0	mm	599

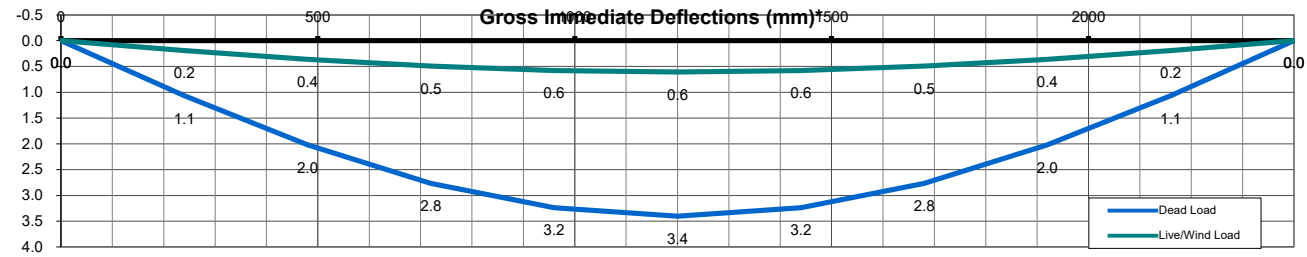
δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered







3000x200x100 Concrete Sleeper

CONCRETE MEMBER V5.02

ramsetreid

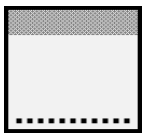
Section:	**(3000x200x100 Concrete Sleeper) 100mm (D) x 200mm (W) beam, f'c=40MPa**	
Reinf't:	**2.0-N12 bottom, ku = 0.34**	
Strength:	**(+ve M) M* = 4.1kNm < øMuo = 5.0kNm**	**OK (0.82)**
Cracking:	**fscr = 262MPa < Fscr = 330MPa & fscr1 = 262MPa < Fscr1 = 400MPa**	**OK (0.66,0.79)**
Ast.min:	**Ast.min = 47mm² < Ast = 226mm² (Minimum of Deemed and actual)**	**OK (0.21)**

Geometry

S.Wt = 0.50 kN/m L/D ratio = 30.0

Concrete strength (f'c) = 40 MPa

Depth (D) = 100 mm
Web width (W) = 200 mm, (S)lab
Flange width (Bf) = 200 mm
Flange thickness (Tf) = 0 mm



Side cover = 30 mm
Concrete weight = 25.0 kN/m³
Fully enclosed = N (Y)es,(N)o
Gross area (Ag) = 20000 mm²

Formwork = S (S)tandard,(R)igid
Exposure top = B2 Tab 4.10.3.2
Exposure bottom = B1 Tab 4.10.3.2
Side = B1 Tab 4.10.3.2

Analysis: simple beam at midspan (Max +ve M)

Analysis values = X (M)anual, (L)eft, Position (X) from analysis, (R)ight

Refer to the analysis output

	Left	Max+	Right	Units
M*	0.0	4.1	0.0	kNm
Ms1*	0.0	3.3	0.0	kNm
Ms*	0.0	3.3	0.0	kNm
Ast req'd	0	181	0	mm²
Ast	226	226	226	mm²
Reinf't req'd	-	1.6-N12	-	

Reinforcement

Ligs = No ligs

Bottom steel = 2.0-N12			**Top steel = 0.0-N12**		
Bar size =	12	mm	Bar size =	12	mm
Bar cts/No/mm² =	2	No	Bar cts/No/mm² =	0	No
Yield strength (fsy) =	500	MPa	Yield strength (fsyc) =	500	MPa
Bottom cover to ligs =	30	mm	Top cover to ligs =	50	mm
Steel area (Ast) =	226	mm²	Steel area (Asc) =	0	mm²
Ductility class =	A	(N)ormal,(L)ow,(A)uto	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Reinf't ductility class =	N	(N)ormal,(L)ow	Reinf't ductility class =	N	(N)ormal,(L)ow
Depth to bottom steel layer (ds.max) =	64	mm	Depth to top steel layer =	56	mm
Depth to bottom steel (ds) =	64	mm	Depth to top steel =	56	mm
D-ds =	36	mm	D-ds =	44	mm
No. bars =	2.0	No.	No. bars =	0.0	No.
Bar centres =	128	mm	Bar centres =	0	mm
Max bars per layer =	3		Max bars per layer =	1	
Layers required =	1		Max bars pers 2nd layer =	0	
			Layers required =	0	

Strength in +ve bending at midspan (Max +ve M) for beams - Cl 8.1

Design width (W) =	200	mm	Design flange (bef) =	200	mm
Tensile steel area (As) =	226	mm²	ds =	64	mm
Comp. steel area (Ac) =	0	mm²	dc =	56	mm
Ultimate Moment (Mu) =	6.3	kNm	ku =	0.337	
Design capacity (øMuo) =	5.0	kNm	ø =	0.800	Table 2.2.2
			Ast.min =	47	mm²

Crack control in +ve bending at midspan (Max +ve M) for beams - Cl 8.6

Steel stress (fscr) =	262	MPa	Max. stress (Fscr) =	330	MPa	OK (0.79)
Steel stress (fscr1) =	262	MPa	Max. stress (Fscr1) =	400	MPa	OK (0.66)

Geometry for (3000x200x100 Concrete Sleeper): Concrete simple beam

Description =	100mm (D) x 200mm (W) beam		Ix =	16.66666667	x10⁶ mm⁴
Span (L) =	3000	mm			
Span type =	S	(S)imple,(E)xt,(I)nt,(C)ant,(P)rop,(F)ixed,(O)ther	Ag =	20000	mm²
Material type =	C	(T)imber,(S)teel,(C)onc.,(SC)comp. steel,(O)ther	Density =	25	kN/m³
			E =	33351	MPa

Loading

	Uniform loads (kN/m)			Point loads (kN)			
Uniform loads	**UDL**	**Partial 1**	**Partial 2**	**Point loads**	**PL 1**	**PL 2**	**PL 3**
Dead load (wdl) =	2.56			Dead load (pdl) =			
Live load (wll) =	0.40			Live load (pll) =			
Start from LHS (mm) =	0			Pos. from LHS (mm) =			
End from LHS (mm) =	3000			Ultimate load (p*) =	0.00	0.00	0.00
S.Wt =	0.00	kN/m					
Ultimate load (w*) =	3.67	0.00	0.00	Include S.Wt =	N	(Y)es,(N)o	
				Strength loadcase =	C	(D)ead Only,(C)omb.	
Live Load type =	Permanent	(Concrete)					
Short term LL (Ψsu) =	1.00	(Ψsp) =	1.00				
Long term LL (Ψlu) =	1.00	(Ψlp) =	1.00				
Actual LL (Ψsa) =	1.00	(Ψla) =	1.00				

Results at midspan (Max +ve M)

Position of result (x) = 1500 mm

1.20*G+1.50*Q analysed

	Left	At x	Right	Max	At	Min	At	Units	
Rdl	3.84		3.84					kN	
Rll	0.60		0.60					kN	
R*	5.51		5.51					kN	
M*	0.00	4.13	0.00	4.13	1500	0.00	0	kNm	
V*	5.51	0.00	-5.51	5.51	0			kN	**Span /**
δdl	0.00	4.86	0.00	4.86	1500	0.00	0	mm	618
δll	0.00	0.76	0.00	0.76	1500	0.00	0	mm	3953
δdl+Ψs*δll	0.00	5.62	0.00	5.62	1500	0.00	0	mm	534

δPll/δTot.ll = 0.00

Graphs

* Deflections are Gross Ig immediate - assessment of long term effects to be considered