

Cranked beam B2

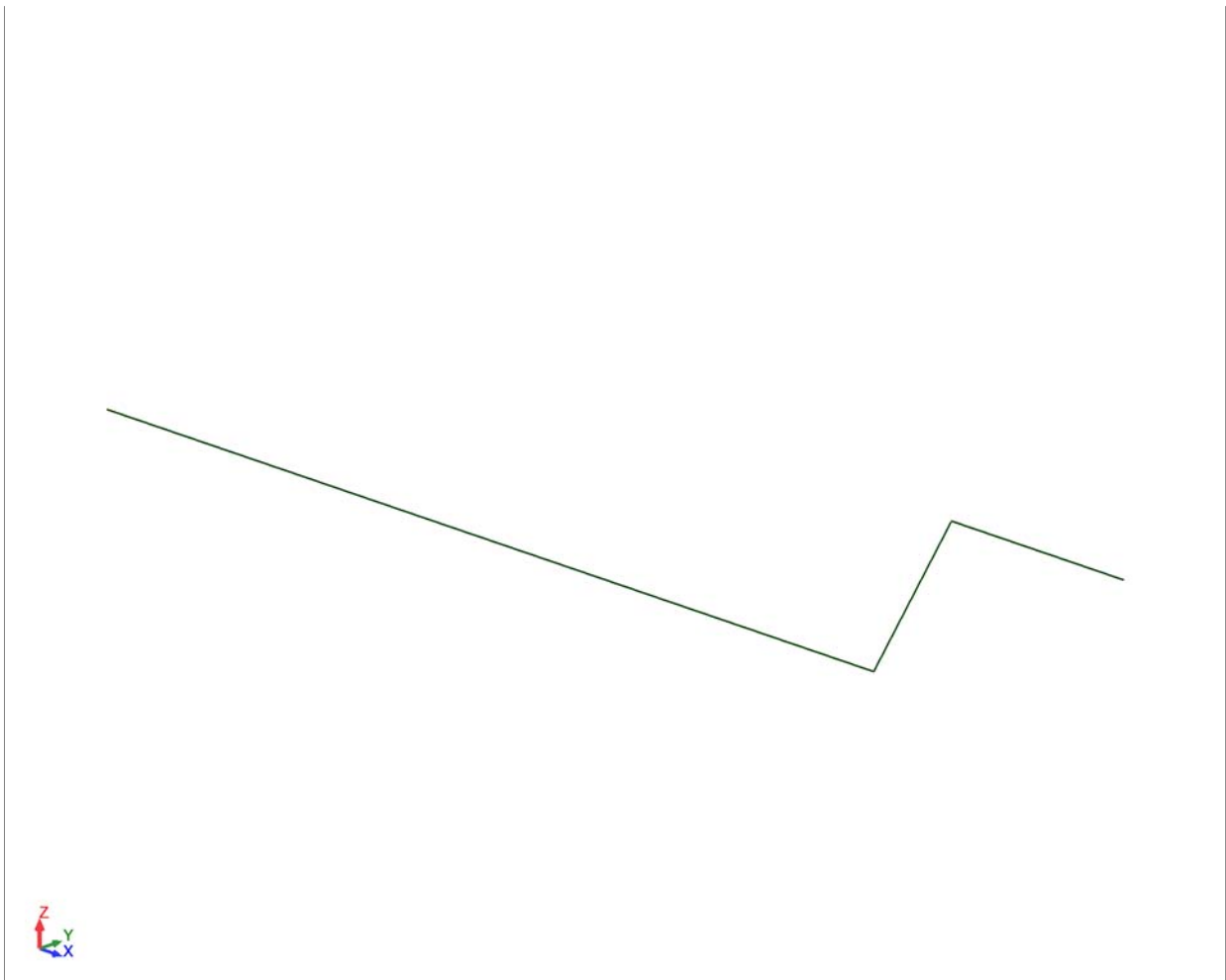
Project: 163 Sumatra Road

RP DESIGNS

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Structure View



Data - Nodes

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	6.90	0.0		
3	7.60	1.20		
4	9.15	1.20	xxf	Pinned

Data - Bars

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)	Type
1	1	2	UC 203x203x60	S355	6.90	0.0	Beam
2	2	3	UC 203x203x60	S355	1.39	0.0	Beam
3	3	4	UC 203x203x60	S355	1.55	0.0	Beam

Data - Sections

Section name	Bar list	AX (mm ²)	AY (mm ²)	AZ (mm ²)	IX (mm ⁴)	IY (mm ⁴)	IZ (mm ⁴)
UC 203x203x60	1to3	7640	5828	1949	472000	61250000	20650000

Data - Materials

Material	E (MPa)	G (MPa)	NI	LX (1/°C)	RO (kN/m ³)	Re (MPa)
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1	S-3-5-5	205000.00	80000.00	0.30	0.00	77.01	355.00
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Data - Supports

Support name	List of nodes	List of edges	List of objects	Support conditions
Pinned	1 4			UX UZ

Loads - Cases

Case	Label	Case name	Nature	Analysis type
1	DL1	DL1	Structural	Static - Linear
2	DL2	DL2	Structural	Static - Linear
3	LL1	LL1	Category A	Static - Linear
4	WIND1	WIND1	w ind	Static - Linear
5		ULS		Static - Linear
6		ULS+		Static - Linear
7		ULS-		Static - Linear
8		SLS		Static - Linear
9		SLS+		Static - Linear
10		SLS-		Static - Linear
11		FIRE		Static - Linear
12		FIRE+		Static - Linear

13		FIRE-	Static - Linear
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Loads - Values

Case	Load type	List	Load values
1	self-w eight	1to3	PZ Negative Factor=1.00
1	self-w eight	1to3	PZ Negative Factor=1.00
2	uniform load	1to3	PZ=-2.50(kN/m)
2	bar force	1	FX=-22.00(kN) X=4.80(m)
2	bar force	1	FZ=-22.00(kN) X=4.80(m)
2	nodal force	2 3	FZ=-2.00(kN)
3	uniform load	1to3	PZ=-1.25(kN/m)
3	bar force	1	FZ=-9.00(kN) X=4.80(m)
3	nodal force	2 3	FZ=-1.00(kN)
4	uniform load	2	PX=1.25(kN/m)

Reactions - Values

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1	-17.43	3.27	-0.00
1/ 2	-74.19	10.47	-0.00
1/ 3	-43.13	4.94	-0.00
1/ 4	-0.89	-0.00	-0.00
1/ ULS+	-91.62	25.95	-0.00
1/ ULS-	-189.17	13.73	-0.00
1/ SLS+	-91.62	18.67	-0.00
1/ SLS-	-135.28	13.73	-0.00
1/ FIRE+	-91.62	16.20	-0.00
1/ FIRE-	-113.18	13.74	-0.00
4/ 1	17.43	8.31	-0.00
4/ 2	96.19	40.13	-0.00
4/ 3	43.13	18.36	-0.00
4/ 4	-0.85	0.00	-0.00
4/ ULS+	218.07	92.94	-0.00
4/ ULS-	112.35	48.44	-0.00
4/ SLS+	156.74	66.80	-0.00
4/ SLS-	112.77	48.44	-0.00
4/ FIRE+	135.18	57.62	-0.00
4/ FIRE-	113.45	48.44	-0.00
Case 1	DL1		
Sum of val.	0.00	11.58	-0.00
Sum of reac.	0.00	11.58	-55.14
Sum of forc.	0.00	-11.58	55.14
Check val.	0.00	-0.00	0.00

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
Precision	2.39024e-014	8.76281e-030	
Case 2	DL2		
Sum of val.	22.00	50.60	-0.00
Sum of reac.	22.00	50.60	-251.75
Sum of forc.	-22.00	-50.60	251.75
Check val.	-0.00	-0.00	0.00
Precision	2.01960e-014	1.87122e-029	
Case 3	LL1		
Sum of val.	-0.00	23.30	-0.00
Sum of reac.	-0.00	23.30	-116.27
Sum of forc.	0.0	-23.30	116.27
Check val.	-0.00	-0.00	0.00
Precision	1.21266e-014	1.80416e-029	
Case 4	WIND1		
Sum of val.	-1.74	-0.00	-0.00
Sum of reac.	-1.74	-0.00	-1.04
Sum of forc.	1.74	0.0	1.04
Check val.	-0.00	-0.00	0.00
Precision	1.47300e-015	4.76212e-030	
Case ULS+	ULS+		
Sum of val.	126.45	118.89	-0.00
Sum of reac.	29.70	83.94	-414.29
Sum of forc.	-29.70	-83.94	414.29
Check val.	-0.00	-0.00	0.00
Precision	5.95328e-014	3.70912e-029	
Case ULS-	ULS-		
Sum of val.	-76.83	62.17	-0.00
Sum of reac.	29.70	83.94	-414.29
Sum of forc.	-29.70	-83.94	414.29
Check val.	-0.00	-0.00	0.00
Precision	5.95328e-014	3.70912e-029	
Case SLS+	SLS+		
Sum of val.	65.13	85.48	-0.00
Sum of reac.	20.26	62.18	-307.93
Sum of forc.	-20.26	-62.18	307.93
Check val.	-0.00	-0.00	0.00
Precision	4.55714e-014	3.22371e-029	
Case SLS-	SLS-		
Sum of val.	-22.51	62.17	-0.00
Sum of reac.	20.26	62.18	-307.93

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
Sum of forc.	-20.26	-62.18	307.93
Check val.	-0.00	-0.00	0.00
Precision	4.55714e-014	3.22371e-029	
Case FIRE+			
Sum of val.	43.56	73.83	-0.00
Sum of reac.	21.65	62.18	-307.09
Sum of forc.	-21.65	-62.18	307.09
Check val.	-0.00	-0.00	0.00
Precision	4.43930e-014	2.84274e-029	
Case FIRE-			
Sum of val.	0.27	62.18	-0.00
Sum of reac.	21.65	62.18	-307.09
Sum of forc.	-21.65	-62.18	307.09
Check val.	-0.00	-0.00	0.00
Precision	4.43930e-014	2.84274e-029	

Reactions ULS: global extremes

	FX (kN)	FZ (kN)	MY (kNm)
MAX	218.07	92.94	-0.00
Node	4	4	1
Case	ULS/3	ULS/2	4
MIN	-189.17	-0.00	-0.00
Node	1	1	4
Case	ULS/2	4	ULS/2

Displacements - Values

Node/Case	UX (mm)	UZ (mm)	RY (Rad)
1/ 1	0.0	0.0	0.001
1/ 2	0.0	0.0	0.005
1/ 3	0.0	0.0	0.002
1/ 4	0.0	0.0	0.000
1/ ULS+	0.0	0.0	0.011
1/ ULS-	0.0	0.0	0.006
1/ SLS+	0.0	0.0	0.008
1/ SLS-	0.0	0.0	0.006
1/ FIRE+	0.0	0.0	0.007
1/ FIRE-	0.0	0.0	0.006
2/ 1	0	-1	-0.000

Node/Case	UX (mm)	UZ (mm)	RY (Rad)
2/ 2	0	-7	-0.001
2/ 3	0	-3	-0.000
2/ 4	0	-0	0.000
2/ ULS+	1	-9	-0.001
2/ ULS-	0	-17	-0.001
2/ SLS+	1	-9	-0.001
2/ SLS-	0	-12	-0.001
2/ FIRE+	1	-9	-0.001
2/ FIRE-	0	-10	-0.001
3/ 1	-0	-1	-0.000
3/ 2	-0	-7	-0.002
3/ 3	-0	-3	-0.001
3/ 4	0	-0	-0.000
3/ ULS+	-0	-8	-0.002
3/ ULS-	-0	-16	-0.005
3/ SLS+	-0	-8	-0.002
3/ SLS-	-0	-11	-0.003
3/ FIRE+	-0	-8	-0.002
3/ FIRE-	-0	-10	-0.003
4/ 1	0.0	0.0	-0.001
4/ 2	0.0	0.0	-0.006
4/ 3	0.0	0.0	-0.003
4/ 4	0.0	0.0	-0.000
4/ ULS+	0.0	0.0	-0.007
4/ ULS-	0.0	0.0	-0.013
4/ SLS+	0.0	0.0	-0.007
4/ SLS-	0.0	0.0	-0.009
4/ FIRE+	0.0	0.0	-0.007
4/ FIRE-	0.0	0.0	-0.008

Displacements SLS: global extremes

	UX (mm)	UZ (mm)	RY (Rad)
MAX	1	0.0	0.008
Node	2	1	1
Case	SLS/2	1	SLS/2
MIN	-0	-12	-0.009
Node	3	2	4
Case	SLS/3	SLS/2	SLS/2

Forces - Envelope

Bar/Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1/ 4	-0.89- >>	-0.00	-0.00
1/ 2/ ULS/2	-218.- 87<<	-64.44	- 74.49
1/ 1/ ULS/3	- 188.37	25.9- 5>>	-0.00
1/ 2/ ULS/2	- 218.87	-64.4- 4<<	- 74.49
1/ 1/ 4	-0.89	-0.00	-0.0- 0>>
1/ 2/ ULS/2	- 218.87	- 64.44	-74.- 49<<
2/ 3/ 4	0.42>- >	-0.73	0.00
2/ 3/ ULS/- 2	-176- .99<<	148.33	135.84
2/ 2/ ULS/2	- 169.57	154.- 47>>	- 74.49
2/ 3/ 4	0.42	-0.73- <<	0.00
2/ 3/ ULS/- 2	- 176.99	148.33	135.- 84>>
2/ 2/ ULS/- 2	- 169.57	154.47	-74.- 49<<
3/ 3/ 4	0.85>- >	-0.00	0.00
3/ 3/ ULS/2	-217.- 31<<	- 82.34	135.84
3/ 3/ 4	0.85	-0.00- >>	0.00
3/ 4/ ULS/2	- 217.31	-92.9- 4<<	0.00
3/ 3/ ULS/2	- 217.31	- 82.34	135.- 84>>
3/ 4/ 4	0.85	-0.00	0.00- <<

Member Forces ULS: envelope

Bar	FX (kN)	FZ (kN)	MY (kNm)
1 / MAX	-0.89	25.95	-0.00
Node	1	1	1
Case	4	ULS/3	4
1 / MIN	- 218.87	- 64.44	- 74.49
Node	2	2	2
Case	ULS/2	ULS/2	ULS/- 2
2 / MAX	0.42	154.47	135.84
Node	3	2	3

Bar	FX (kN)	FZ (kN)	MY (kNm)
Case	4	ULS/2	ULS/- 2
2 / MIN	- 176.99	-0.73	- 74.49
Node	3	3	2
Case	ULS/2	4	ULS/- 2
3 / MAX	0.85	-0.00	135.84
Node	3	3	3
Case	4	4	ULS/- 2
3 / MIN	- 217.31	- 92.94	0.00
Node	3	4	4
Case	ULS/2	ULS/2	4

Stresses - Global extremes

	S max (MPa)	S min (MPa)	S max (My) (MPa)	S min (My) (MPa)	Fx/Ax (MPa)
MAX	209.27	0.11	232.43	-0.00	0.11
Bar	2	3	3	1	3
Node	3	4	3	1	3
Case	ULS/2	4	ULS/2	4	4
MIN	- 28.54	- 260.97	-0.00	- 232.43	- 28.65
Bar	3	3	1	3	1
Node	4	3	1	3	2
Case	ULS/3	ULS/3	4	ULS/2	ULS/2

Members - Definition

Member	Name	Components	Code group	Section	Type	Ly (m)	Lz (m)
1	Beam_1	1	(NA)	UC 203x203x60	Beam	6.90	6.90
2	Beam_2	2	(NA)	UC 203x203x60	Beam	1.39	1.39
3	Beam_3	3	(NA)	UC 203x203x60	Beam	1.55	1.55

STEEL DESIGN

CODE: BS-EN 1993-1:2005/NA:2008/AC:2009, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 1 Beam_1

POINT: 3

COORDINATE: x = 1.00 L = 6.90 m

LOADS:

Governing Load Case: 5 ULS /2/ 1*1.35 + 2*1.35 + 3*1.50 + 4*0.90

MATERIAL:

S355 (S355) $f_y = 355.00$ MPa

**SECTION PARAMETERS: UC 203x203x60**

h=210 mm
b=206 mm
tw=9 mm
tf=14 mm

gM0=1.00

Ay=6128 mm²

Iy=61250000 mm⁴

Wply=656000 mm³

gM1=1.00

Az=2218 mm²

Iz=20650000 mm⁴

Wplz=305000 mm³

Ax=7640 mm²

Ix=472000 mm⁴

INTERNAL FORCES AND CAPACITIES:

N,Ed = -218.87 kN

Nt,Rd = 2712.20 kN

My,Ed = -74.49 kN*m

My,pl,Rd = 232.88 kN*m

My,c,Rd = 232.88 kN*m

MN,y,Rd = 232.88 kN*m

Mb,Rd = 148.24 kN*m

Vz,Ed = -64.44 kN

Vz,c,Rd = 454.69 kN

Class of section = 1

**LATERAL BUCKLING PARAMETERS:**

z = 1.00

Lcr,low=6.90 m

Mcr = 183.23 kN*m

Lam_LT = 1.13

Curve,LT - b

fi,LT = 1.10

XLT = 0.62

XLT,mod = 0.64

BUCKLING PARAMETERS:

About y axis:



About z axis:

VERIFICATION FORMULAS:**Section strength check:**

$N_{Ed}/N_{t,Rd} = 0.08 < 1.00$ (6.2.3.(1))

$M_{y,Ed}/M_{y,c,Rd} = 0.32 < 1.00$ (6.2.5.(1))

$V_{z,Ed}/V_{z,c,Rd} = 0.14 < 1.00$ (6.2.6.(1))

Global stability check of member:

$M_{y,Ed}/M_{b,Rd} = 0.50 < 1.00$ (6.3.2.1.(1))

LIMIT DISPLACEMENTS**Deflections**

$u_y = 0$ mm < $u_{y,max} = L/200.00 = 35$ mm

Verified

Governing Load Case: 1 DL1

$uz = 12 \text{ mm} < uz \text{ max} = L/200.00 = 35 \text{ mm}$

Verified

Governing Load Case: 8 SLS /3/ 1*1.00 + 2*1.00 + 3*1.00



Displacements Not analyzed

Section OK !!!

STEEL DESIGN

CODE: BS-EN 1993-1:2005/NA:2008/AC:2009, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 2 Beam_2
m

POINT: 3

COORDINATE: x = 1.00 L = 1.39

LOADS:

Governing Load Case: 5 ULS /2/ 1*1.35 + 2*1.35 + 3*1.50 + 4*0.90

MATERIAL:

S355 (S355) $f_y = 355.00$ MPa



SECTION PARAMETERS: UC 203x203x60

h=210 mm	gM0=1.00	gM1=1.00	
b=206 mm	Ay=6128 mm ²	Az=2218 mm ²	Ax=7640 mm ²
tw=9 mm	Iy=61250000 mm ⁴	Iz=20650000 mm ⁴	Ix=472000 mm ⁴
tf=14 mm	Wply=656000 mm ³	Wplz=305000 mm ³	

INTERNAL FORCES AND CAPACITIES:

N,Ed = -176.99 kN	My,Ed = 135.84 kN*m	
Nt,Rd = 2712.20 kN	My,pl,Rd = 232.88 kN*m	
	My,c,Rd = 232.88 kN*m	Vz,Ed = 148.33 kN
	MN,y,Rd = 232.88 kN*m	Vz,c,Rd = 454.69 kN
	Mb,Rd = 232.88 kN*m	

Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00	Mcr = 1676.86 kN*m	Curve,LT - b	XLT = 1.00
Lcr,upp=1.39 m	Lam_LT = 0.37	fi,LT = 0.55	XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:



About z axis:

VERIFICATION FORMULAS:

Section strength check:

$N,Ed/Nt,Rd = 0.07 < 1.00$ (6.2.3.(1))

$My,Ed/My,c,Rd = 0.58 < 1.00$ (6.2.5.(1))

$Vz,Ed/Vz,c,Rd = 0.33 < 1.00$ (6.2.6.(1))

Global stability check of member:

$My,Ed/Mb,Rd = 0.58 < 1.00$ (6.3.2.1.(1))

LIMIT DISPLACEMENTS



Deflections

$u_y = 0$ mm < u_y max = L/200.00 = 7 mm Verified

Governing Load Case: 1 DL1

$u_z = 1$ mm < u_z max = L/200.00 = 7 mm Verified

Governing Load Case: 8 SLS /2/ 1*1.00 + 2*1.00 + 3*1.00 + 4*0.60



Displacements Not analyzed

Section OK !!!

STEEL DESIGN

CODE: *BS-EN 1993-1:2005/NA:2008/AC:2009, Eurocode 3: Design of steel structures.*

ANALYSIS TYPE: *Member Verification*

CODE GROUP:

MEMBER: 3 *Beam_3*
m

POINT: 1

COORDINATE: *x = 0.00 L = 0.00*

LOADS:

*Governing Load Case: 5 ULS /2/ 1*1.35 + 2*1.35 + 3*1.50 + 4*0.90*

MATERIAL:

S355 (S355) $f_y = 355.00$ MPa



SECTION PARAMETERS: UC 203x203x60

h=210 mm

gM0=1.00

gM1=1.00

b=206 mm

Ay=6128 mm²

Az=2218 mm²

Ax=7640 mm²

tw=9 mm

Iy=61250000 mm⁴

Iz=20650000 mm⁴

Ix=472000 mm⁴

tf=14 mm

Wply=656000 mm³

Wplz=305000 mm³

INTERNAL FORCES AND CAPACITIES:

N,Ed = -217.31 kN

My,Ed = 135.84 kN*m

Nt,Rd = 2712.20 kN

My,pl,Rd = 232.88 kN*m

My,c,Rd = 232.88 kN*m

Vz,Ed = -82.34 kN

MN,y,Rd = 232.88 kN*m

Vz,c,Rd = 454.69 kN

Mb,Rd = 232.88 kN*m

Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00

Mcr = 1382.26 kN*m

Curve,LT - b

XLT = 1.00

Lcr,upp=1.55 m

Lam_LT = 0.41

fi,LT = 0.56

XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:



About z axis:

VERIFICATION FORMULAS:

Section strength check:

$N_{Ed}/N_{t,Rd} = 0.08 < 1.00$ (6.2.3.(1))

$M_{y,Ed}/M_{y,c,Rd} = 0.58 < 1.00$ (6.2.5.(1))

$V_{z,Ed}/V_{z,c,Rd} = 0.18 < 1.00$ (6.2.6.(1))

Global stability check of member:

$M_{y,Ed}/M_{b,Rd} = 0.58 < 1.00$ (6.3.2.1.(1))

LIMIT DISPLACEMENTS



Deflections

$u_y = 0$ mm < $u_{y,max} = L/200.00 = 8$ mm

Verified

Governing Load Case: 1 DL1

$u_z = 1$ mm < $u_{z,max} = L/200.00 = 8$ mm

Verified

Governing Load Case: 8 SLS /2/ 1*1.00 + 2*1.00 + 3*1.00 + 4*0.60



Displacements Not analyzed

Section OK !!!

Member Group Design

Connection Verification