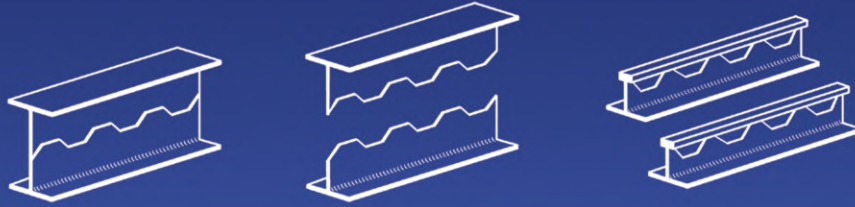




DYSEMMETRIC BEAM CATALOGUE



COMPETITIVE BIDDING

THE GIRDER

WITH PRACTICALLY AN UNLIMITED SOURCE OF SUPPLY, THE  GIRDER IS MANUFACTURED BY YOUR LOCAL STEEL FABRICATORS AS PART OF A COMPLETE STRUCTURAL STEEL PACKAGE.

THE  GIRDER FABRICATION PROCESS BEGINS WITH A STANDARD WIDE FLANGE SECTION THAT WHEN UNIQUELY CUT THROUGH THE WEB, PRODUCES TWO IDENTICAL TEE SECTIONS.

THE FABRICATOR THEN WELDS A FLAT BAR TO THE TOP OF THE REMAINING WEB CREATING THE NARROW TOP FLANGE OF THE  GIRDER.

ALTERNATIVELY, WHERE THE PRODUCTION OF BEAMS IS MORE SUITED TO FABRICATION FROM PLATE PRODUCT AS A WELDED ASSEMBLY, THIS IS AN ACCEPTED ALTERNATIVE TO CUTTING FROM A PARENT BEAM.

TWO  GIRDERS ARE FABRICATED FROM ONE PARENT BEAM WITHOUT WASTE.

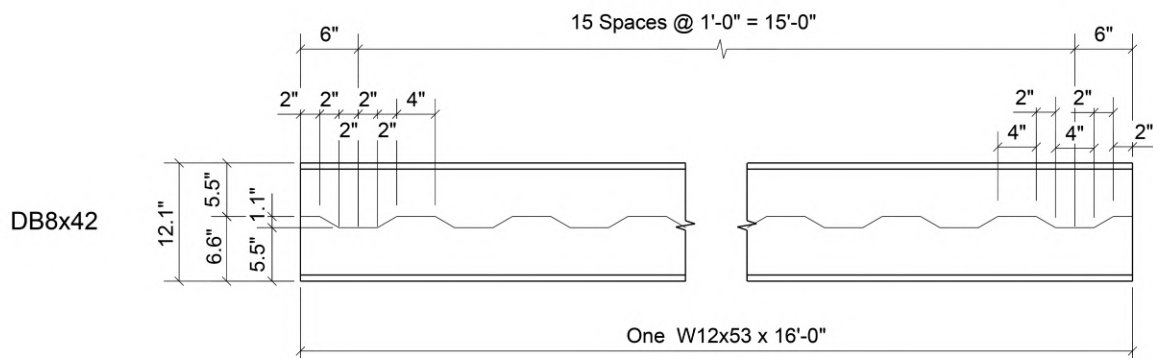
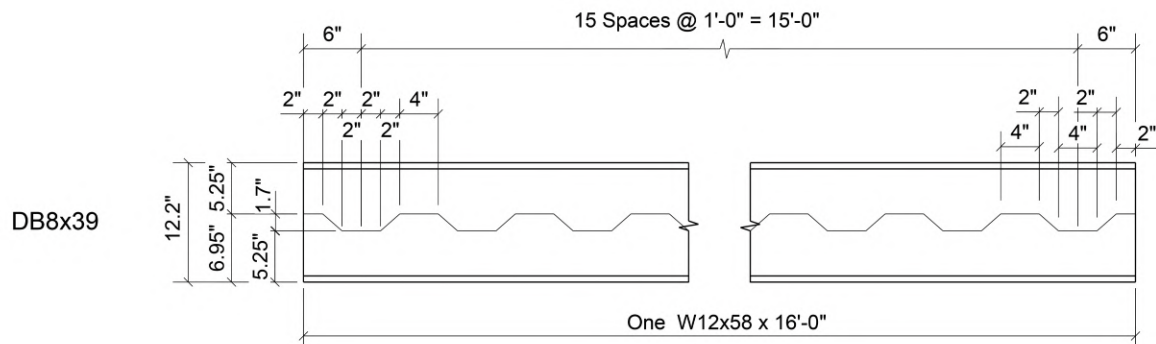
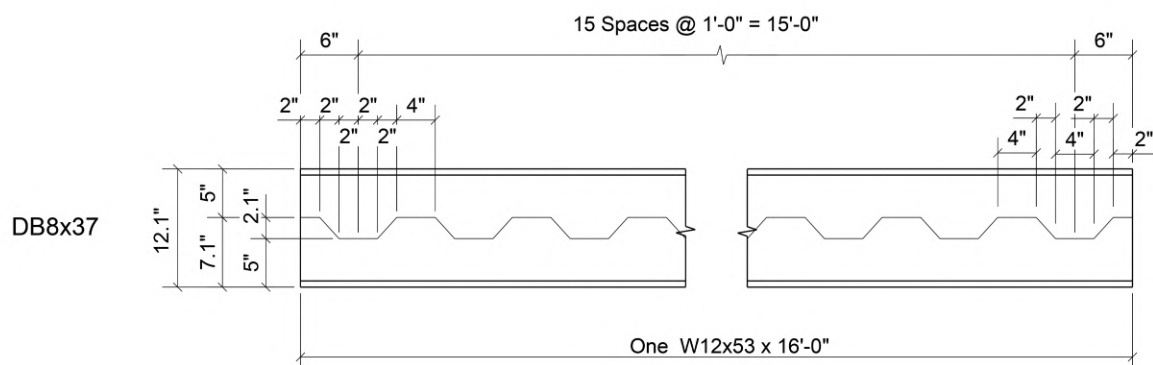
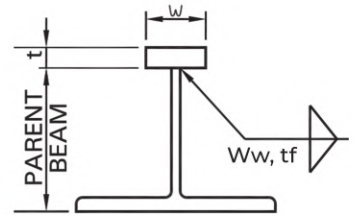
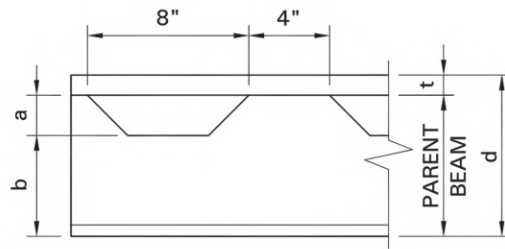


GIRDER DIMENSIONS AND PROPERTIES - US (IMPERIAL)

Designation	Web- included Weight (lb/ft)	Average Area (in ²)	Depth (in)	Parent Rolled Section	Web Plate Width (for Fabrication) (in)	Web Thickness (in)	Bottom Flange Thickness (in)	Bottom Flange Width (in)	Top Flange Width (in)	Top Flange Thickness (in)	Top Flange-to- Web Weld Thickness (in)	Bottom Flange-to- Web Weld Thickness (in)	Castellation & Cutting Dimensions		Noncomposite Section Properties					
													a	b	N _{bot DB}	I _g	S _{bot DB}	S _{top DB}	PNA _{bot DB}	Z
DB8x37	36.7	10.8	8.10	W12x53	-	0.345	0.575	10.0	3	1	5/16	-	2.10	5	2.79	108	38.8	20.4	0.51	26.1
DB8x39	39.2	11.5	7.95	W12x58	-	0.360	0.640	10.0	3	1	5/16	-	1.70	5 1/4	2.65	107	40.6	20.3	0.55	26.2
DB8x42	41.8	12.3	8.10	W12x53	-	0.345	0.575	10.0	3	1 1/2	5/16	-	1.10	5 1/2	3.34	131	39.1	27.4	1.24	36.2
DB8x44 ^a	44.3	13.0	7.95	W12x58	-	0.360	0.640	10.0	3	1 1/2	5/16	-	0.70	5 3/4	3.17	130	41.1	27.2	0.64	36.3
DB8x57	56.5	16.6	8.03	W12x79	-	0.470	0.735	12.1	5	1	5/16	-	1.66	5 3/8	2.96	169	57.1	33.3	0.67	42.2
DB8x61	60.8	17.9	8.03	W12x79	-	0.470	0.735	12.1	5	1 1/4	5/16	-	1.16	5 5/8	3.26	188	57.5	39.3	0.72	50.6
DB9x41	40.7	12.0	9.65	W14x61	-	0.375	0.645	10.0	3	1	5/16	-	3.40	5 1/4	3.10	163	52.7	24.9	0.56	31.5
DB9x44 ^b	44.2	13.0	9.75	W14x68	-	0.415	0.720	10.0	3	1	5/16	-	3.50	5 1/4	2.98	171	57.5	25.3	0.60	32.3
DB9x46	45.8	13.5	9.65	W14x61	-	0.375	0.645	10.0	3	1 1/2	5/16	-	2.40	5 3/4	3.75	201	53.6	34.1	0.64	44.1
DB9x47 ^c	47.2	13.9	9.89	W14x74	-	0.450	0.785	10.1	3	1	5/16	-	3.58	5 5/16	2.89	180	62.4	25.8	0.64	33.3
DB9x49	49.3	14.5	9.75	W14x68	-	0.415	0.720	10.0	3	1 1/2	5/16	-	2.50	5 3/4	3.62	213	58.8	34.7	0.69	45.1
DB9x52	52.3	15.4	9.89	W14x74	-	0.450	0.785	10.1	3	1 1/2	5/16	-	2.58	5 13/16	3.52	226	64.2	35.4	0.73	46.4
DB9x57	56.5	16.6	9.78	W12x79	-	0.470	0.735	12.1	5	1	5/16	-	5.16	3 5/8	3.45	258	74.9	40.8	0.63	47.8
DB9x61	61.4	18.0	9.86	W14x82	-	0.510	0.855	10.1	3	2	3/8	-	1.42	6 7/16	3.85	262	68.1	43.5	1.05	59.7
DB9x65	65.0	19.1	9.78	W12x79	-	0.470	0.735	12.1	5	1 1/2	5/16	-	4.16	4 1/8	4.16	314	75.4	55.9	0.96	68.2
DB9x80	80.1	23.6	9.76	W14x99	-	0.485	0.780	14.6	4	2 1/4	3/8	-	0.82	6 11/16	3.99	355	88.8	61.5	1.28	83.5

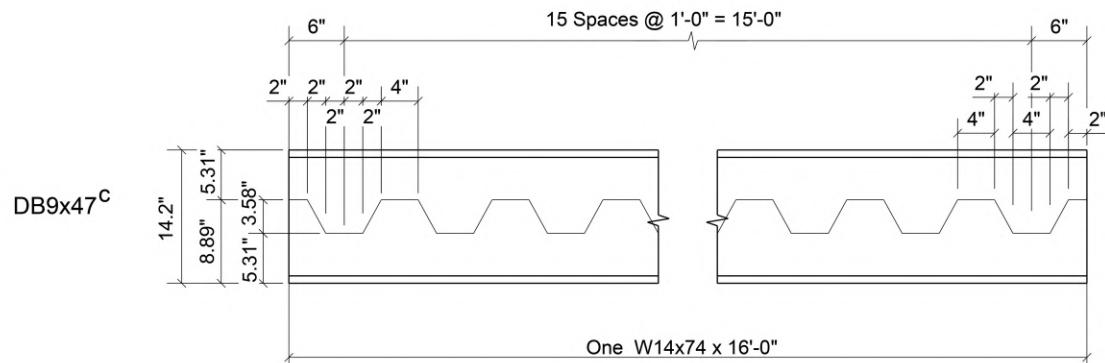
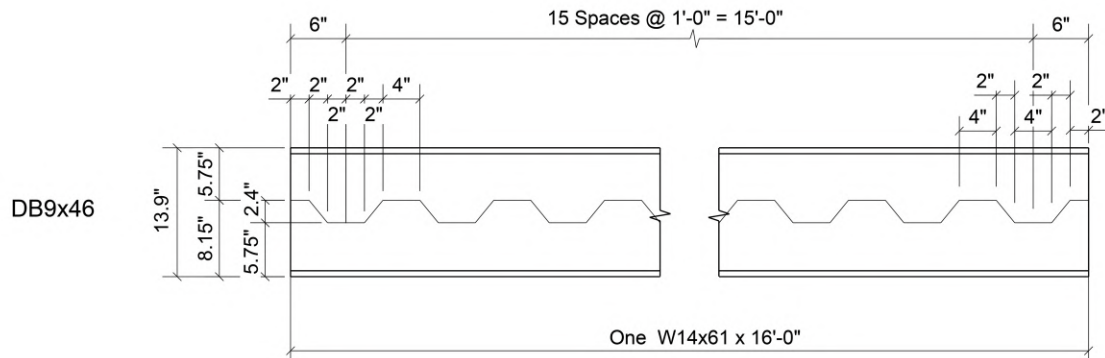
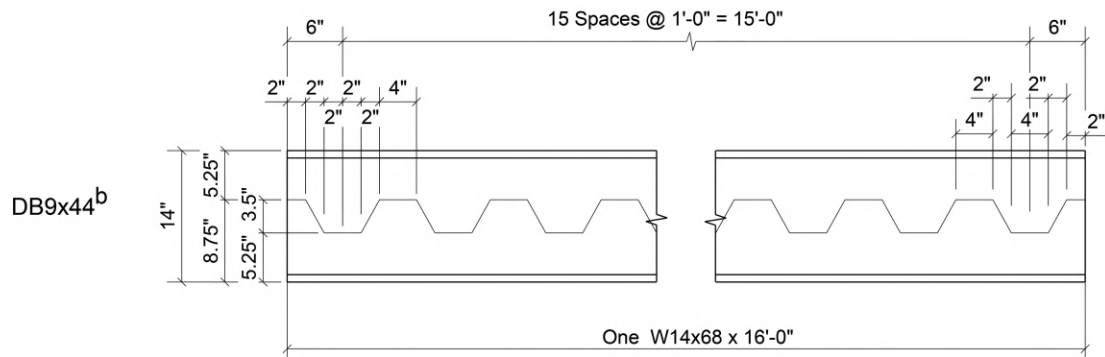
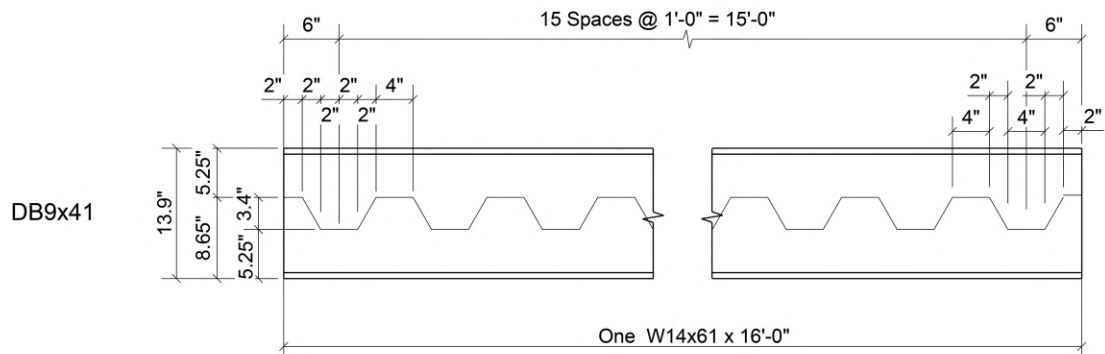
^a Formerly identified as DB8x45; ^b Formerly identified as DB9x45; ^c Formerly identified as DB9x48

GIRDER CUTTING PATTERNS - US (IMPERIAL)



Note: All the dimensions are in feet and inches.

GIRDER CUTTING PATTERNS - US (IMPERIAL)



Note: All the dimensions are in feet and inches.

GIRDER DIMENSIONS AND PROPERTIES - US & CAN - SI (METRIC)

Designation	Web- included Mass	Average Area	Depth	Parent Rolled Section ¹	Web Plate Width (for Fabrication)	Web Thickness	Bottom Flange Thickness	Bottom Flange Width	Top Flange Width	Top Flange Thickness	Top Flange-to- Web Weld Thickness	Bottom Flange-to- Web Weld Thickness	Castellation & Cutting Dimensions		Noncomposite Section Properties					
													a (mm)	b (mm)	I _g (10 ⁶ mm ⁴)	S _{bot} DB (10 ³ mm ³)	S _{top} DB (10 ³ mm ³)	PNA _{bot} DB (mm)	Z (10 ³ mm ³)	
	m (kg/m)	A (mm ²)	d (mm)		d + t + t _f (mm)	t _w (mm)	t _f (mm)	b _f (mm)	w (mm)	t (mm)	W _{eff} (mm)	W _{web} (mm)			NA _{bot} DB (mm)					
DB200x54	54.5	6,950	206	W310x79	-	8.76	14.6	254	76	25	8	-	55	126	70.4	44.7	636	330	13.0	421
DB200x58	57.9	7,400	202	W310x86	-	9.14	16.3	254	76	25	8	-	44	133	66.6	44.3	665	327	14.0	424
DB200x62	62.2	7,938	206	W310x79	-	8.76	14.6	254	76	38	8	-	29	139	84.7	54.3	642	448	30.1	591
DB200x66	65.7	8,388	202	W310x86	-	9.14	16.3	254	76	38	8	-	18	146	80.2	54.1	675	444	16.2	592
DB200x83	83.4	10,675	204	W310x117 [#]	-	11.9	18.7	307	127	25	8	-	43	136	74.6	69.8	935	539	16.8	683
DB200x90	90.4	11,564	204	W310x117 [#]	-	11.9	18.7	307	127	32	8	-	29	143	83.1	78.4	944	648	18.4	834
DB230x60	60.4	7,650	245	W360x91	-	9.53	16.4	254	76	25	8	-	87	133	77.9	67.1	862	402	14.1	508
DB230x65	65.5	8,350	248	W360x101	-	10.50	18.3	254	76	25	8	-	90	133	75.0	70.6	943	408	15.2	522
DB230x68	68.2	8,638	245	W360x91	-	9.53	16.4	254	76	38	8	-	61	146	95.0	83.4	878	556	16.3	720
DB230x70	70.0	8,950	251	W360x110	-	11.40	19.9	257	76	25	8	-	91	135	72.7	74.1	1,019	416	16.2	538
DB230x73	73.2	9,338	248	W360x101	-	10.50	18.3	254	76	38	8	-	64	146	91.7	88.5	966	566	17.4	736
DB230x78	77.7	9,938	251	W360x110	-	11.40	19.9	257	76	38	8	-	65	148	89.1	93.6	1,050	578	18.5	756
DB230x83	83.4	10,675	248	W310x117 [#]	-	11.9	18.7	307	127	25	8	-	131	92	86.8	106.2	1,224	659	15.9	772
DB230x91	91.5	11,626	250	W360x122	-	13.00	21.7	257	76	51	10	-	35	164	97.5	108.6	1,114	712	28.1	978
DB230x96	96.4	12,326	248	W310x117 [#]	-	11.9	18.7	307	127	38	8	-	105	105	105.4	130.0	1,233	912	23.4	1,113
DB230x120	119.9	15,316	248	W360x147	-	12.30	19.8	371	102	58	10	-	19	171	102.2	148.8	1,456	1,021	37.2	1,388

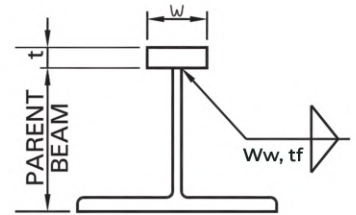
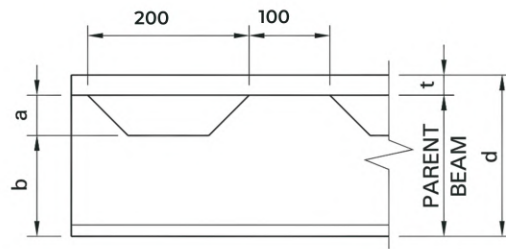
¹ All S.I. dimensions for USA(SI) and Canada parent beams are taken from the AISCS Database of Shapes v15.0. Values may differ very slightly from those listed in the CISC Handbook of Steel Construction 12th Ed.

[#] The W310x117 is an American S.I. designation and should be considered effectively equivalent to the Canadian W310x118. See CISC Handbook of Steel Construction 12th Ed. pp. 6-25.

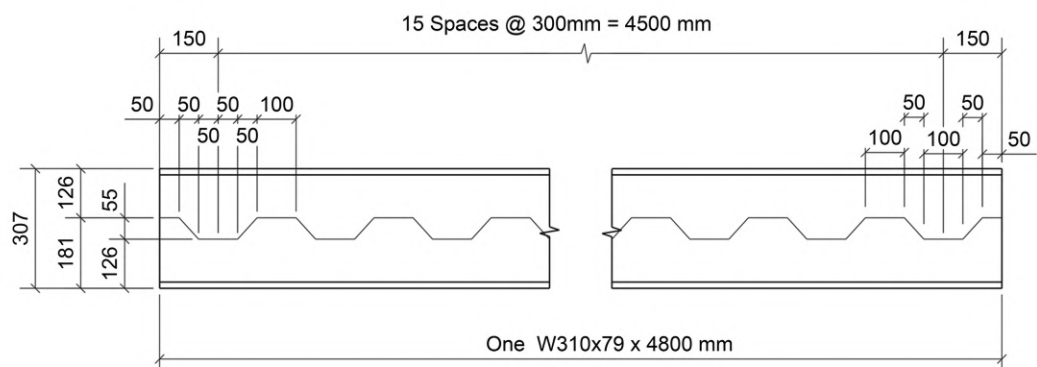
¹ All S.I. dimensions for USA(SI) and Canada parent beams are taken from the AISI Database of Shapes v15.0. Values may differ very slightly from those listed in the CISC Handbook of Steel Construction 12th Ed.

[#] The W310x117 is an American S.I. designation and should be considered effectively equivalent to the Canadian W310x118. See CISC Handbook of Steel Construction 12th Ed. pg. 6-25.

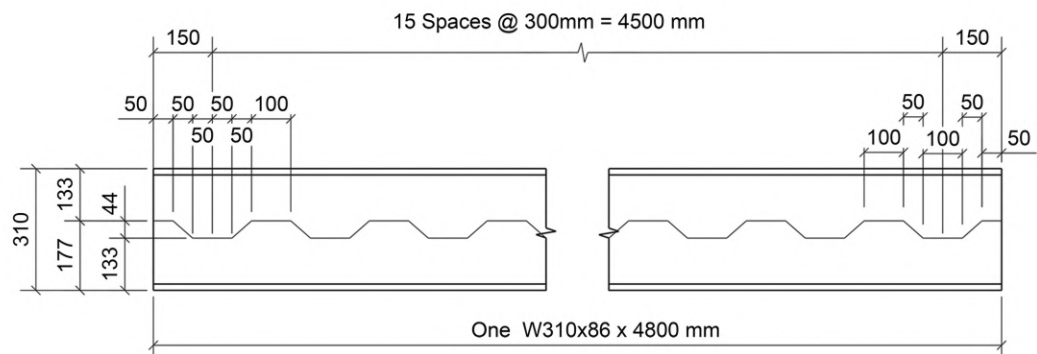
200 GIRDER CUTTING PATTERNS - US & CAN - SI (METRIC)



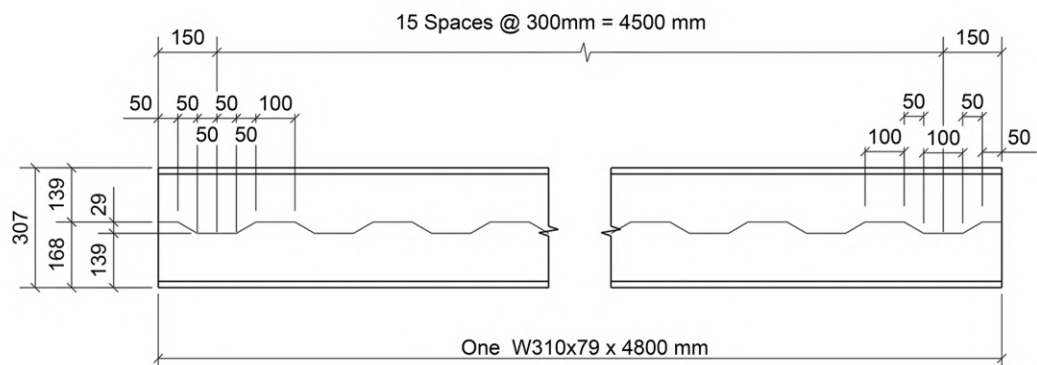
DB200x54



DB200x58

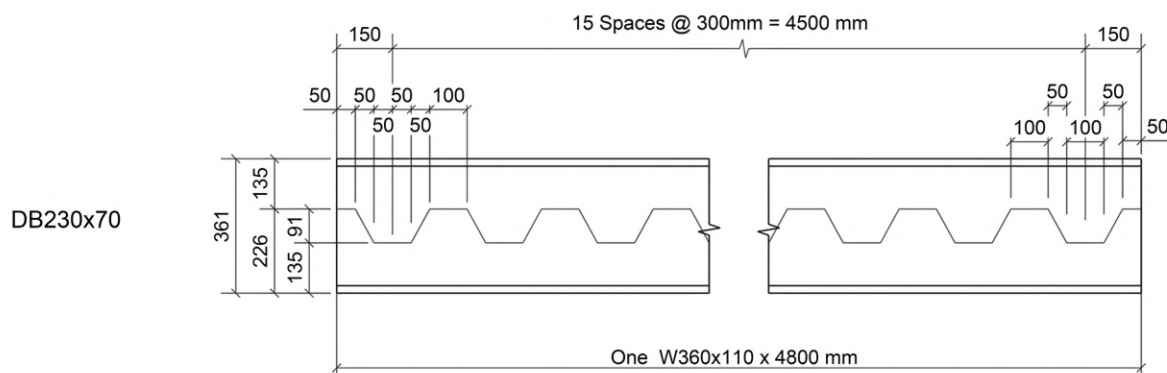
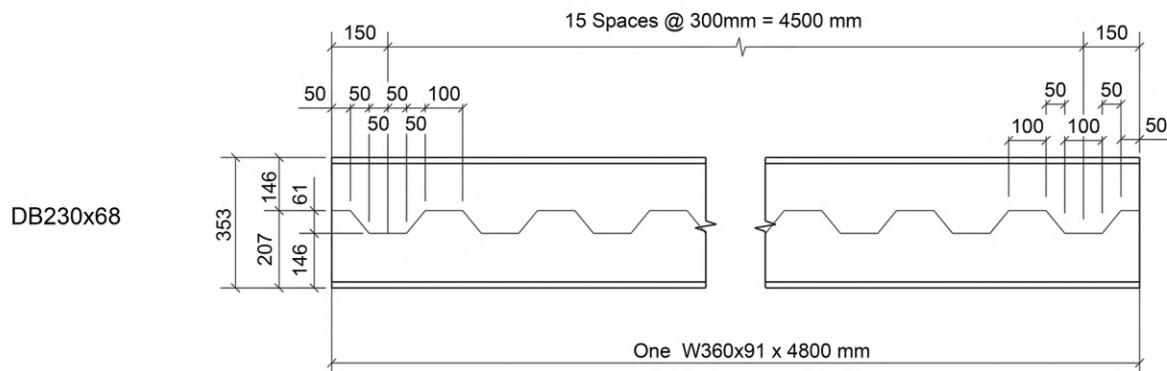
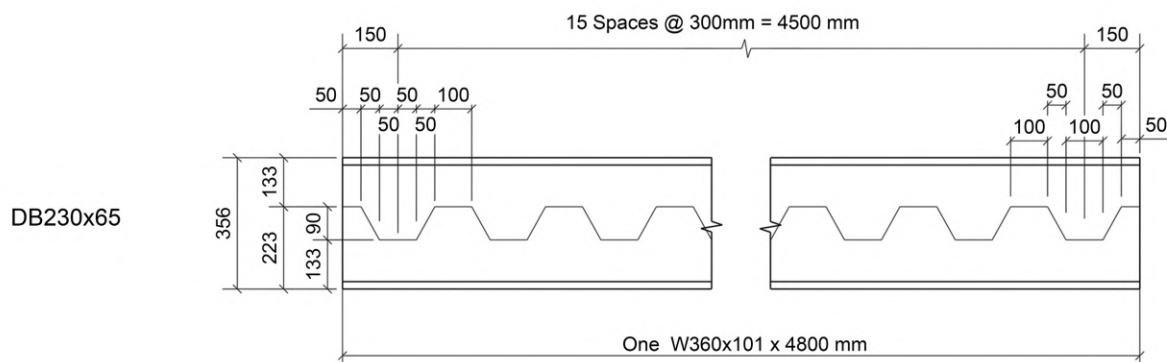
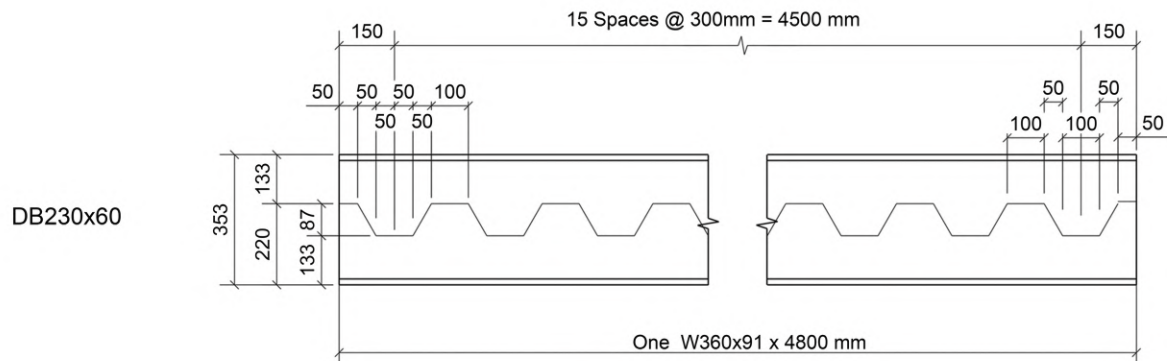


DB200x62



Note: All the dimensions are in mm.

GIRDER CUTTING PATTERNS - US & CAN - SI (METRIC)

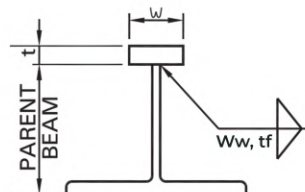
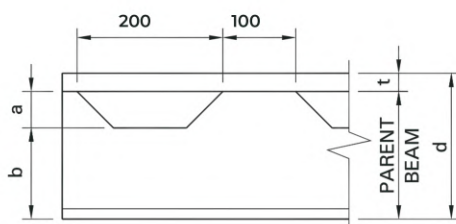


Note: All the dimensions are in mm.

GIRDER DIMENSIONS AND PROPERTIES - AUS/NZ - SI (METRIC)

Designation	Web- included Mass	Average Area	Depth	Parent Rolled Section	Web Plate Width (for Fabrication)	Web Thickness	Bottom Flange Thickness	Bottom Flange Width	Top Flange Width	Top Flange Thickness	Top Flange-to- Web Weld Thickness	Bottom Flange-to- Web Weld Thickness	Castellation & Cutting Dimensions			Noncomposite Section Properties						
													a	b	N _A _{bot} DB	I _y	Z _{bot} DB	Z _{top} DB	PNA _{bot} DB	S		
	m	A	d		d - t - t _f	t _w	t _f	b _f	w	t	w _{w,t} f	w _{w,b} f		a	b	N _A _{bot} DB	I _y	Z _{bot} DB	Z _{top} DB	PNA _{bot} DB	S	
DB200x57a	56.9	7,250	206	-	165	10	16	250	75	25	8	6	55	126	67.8	45.2	667	327	13.9	416		
DB200x57b	57.0	7,265	202	-	161	10	16	250	75	25	8	6	44	133	67.3	43.6	648	324	14.0	417		
DB200x66a	65.6	8,355	206	-	150	10	16	250	75	40	8	6	29	137	83.1	56.3	678	459	23.8	602		
DB200x66b	65.7	8,370	202	-	146	10	16	250	75	40	8	6	18	144	82.2	54.1	659	452	26.9	599		
DB200x84	83.5	10,625	204	310 UC 118	-	11.9	18.7	307	125	25	8	-	43	136	74.1	69.1	933	532	16.6	661		
DB200x85	84.6	10,775	204	-	159	12	20	300	125	25	8	6	43	136	72.9	69.7	955	531	17.4	662		
DB200x90	90.4	11,500	204	310 UC 118	-	11.9	18.7	307	125	32	8	-	29	143	82.5	77.7	942	639	18.2	806		
DB200x91	91.5	11,650	204	-	152	12	20	300	125	32	8	6	29	143	81.2	78.4	966	639	19.0	806		
DB230x59	58.7	7,480	245	-	204	10	16	250	75	25	8	6	87	133	78.8	65.9	836	396	14.0	496		
DB230x66	66.4	8,455	248	-	203	10	20	250	75	25	8	6	90	133	72.2	70.8	981	403	15.9	504		
DB230x67	67.4	8,585	245	-	189	10	16	250	75	40	8	6	61	144	97.8	83.4	854	567	26.9	724		
DB230x69	69.1	8,801	251	-	206	12	20	250	75	25	8	6	91	135	73.2	73.0	998	411	16.4	527		
DB230x77	77.5	9,872	248	-	188	12	20	250	75	40	8	6	64	144	90.2	91.7	1,016	581	18.8	751		
DB230x78	77.7	9,902	251	-	191	12	20	250	75	40	8	6	65	146	91.3	94.3	1,032	590	18.9	763		
DB230x84a	83.5	10,625	248	310 UC 118	-	11.9	18.7	307	125	25	8	-	131	92	86.0	105.1	1,222	649	15.8	742		
DB230x84b	84.0	10,700	250	-	180	12	20	250	75	50	10	6	35	165	100.5	103.2	1,026	690	38.1	923		
DB230x85	84.6	10,775	248	-	203	12	20	300	125	25	8	6	131	92	84.5	106.0	1,254	648	16.5	743		
DB230x98	98.3	12,500	248	310 UC 118	-	11.9	18.7	307	125	40	8	-	101	107	106.8	131.5	1,231	932	27.0	1,117		
DB230x99	99.3	12,650	248	-	188	12	20	300	125	40	8	6	101	107	105.1	133.1	1,266	932	19.8	1,117		
DB230X121	120.9	15,402	248	-	168	12	20	375	100	60	10	6	19	169	101.5	149.7	1,474	1,022	26.8	1,365		

DIBeam
COMPOSITE FLOORING SYSTEM



15 Spaces @ 300mm = 4500 mm

307

150

50

50

50

100

50

50

126

55

181

126

150

50

50

100

100

50

One Built-Up 307x250 x 4800 mm

15 Spaces @ 300mm = 4500 mm

310

150

50 50 50 100

50 50

177

44

133

One Built-Up 310x250 x 4800 mm

150

50 50

100 100

15 Spaces @ 300mm = 4500 mm

303

137

166

29

150

50

50

50

100

50

50

50

100

100

50

50

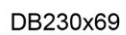
150

50

One Built-Up 303x250 x 4800 mm

PAGE

D-BEAM
COMPOSITE FLOORING SYSTEM



10

Sample Calculations Section of Technical Guide

Smart Green Building Systems International is pleased to release the latest Version of its Technical Tool to assist the design and construction community in selecting appropriately sized  members for project applications. Enhancements to the previous version are:

- Updating to latest jurisdictional codes for loading and material performance in LRFD method of design for the US and Limit States Design for Canada, Australia, and New Zealand.
- Alignment with international composite design methodology.
- Standardization of section properties (both non-composite and composite) and nomenclature.
- Introduction of two new  sizes to meet industry demands for higher loading and/or longer spans.
- Systems International (SI) version is available for design firms interested in extending this structural system to jurisdictions beyond the US, however requiring SI-based design documentation.

Hence, we are providing both the Imperial Unit (Traditional U.S. Unit) and SI Unit (Metric) versions for your design applications.

Also available via download protocol on our website are matching Design Examples plus Notes for each country's adaptation. Designers will find this information useful especially when non-standard conditions arise, and more refined analysis is required.

The following design examples contain extractions from the country and unit-specific Design Examples and accompanying Notes for demonstration purposes.

SAMPLE CALCULATIONS

“8” GIRDER WITH 8” HOLLOW-CORE US (IMPERIAL) LRFD

Summary of Design Requirement Checks

In this example, all eleven design requirements were satisfied. A summary of all checks is provided in Table 13.

Design Requirement	Value (Demand)	Limit (Capacity)	Result
Strength			
Element Slenderness - Top Flange	2.50	9.15	OK
Element Slenderness - Top Flange over Castellations	19.40	20.00	OK
Element Slenderness - Web	17.32	48.62	OK
Strength - Top Flange to Web Connection	250.0 kips	605.0 kips	OK
Strength - Shear on Composite Section	45.38 kips	68.15 kips	OK
Strength - Moment on Bottom Flange (Transverse Loading)	0.78 kip•ft/ft	6.08 kip•ft/ft	OK
Strength- Moment on Noncomposite Section	143.63 kip•ft	158.36 kip•ft	OK
Strength- Moment on Composite Section	249.56 kip•ft	289.47 kip•ft	OK
Ductility			
Strain - Bottom Flange Flexural Strain at Ultimate	0.003448	0.011376	OK
Serviceability			
Deflection - Live Load	0.514 in	0.733 in	OK
Deflection - Total Load (Net)	0.709 in	1.100 in	OK

Table 13 - Summary of Design Checks



Design Example: ANSI/AISC 360-16 [AISC *Steel Construction Manual* (15th Ed.)]
LRFD Method / Traditional U.S. Units / Standard  / Untopped / Unshored

Design requirements are in accordance with ANSI/AISC 360-16 specification and associated AISC Steel Construction Manual 15th Edition. Requirements also satisfy earlier editions of the specification (ANSI/AISC 360-10 [AISC 14th Ed.] and (ANSI/AISC 360-05 [AISC 13th Ed.]).

Project Name / Job #

CAUTION: SOME INPUT VALUES HAVE CHANGED. CROSS SECTION ANALYSIS MUST BE RERUN!

ANALYZE

Dysemmetric Beam

Dysemmetric Beam Section = DB8x57
Top Flange Yield Stress = 50 ksi
Parent W Beam Yield Stress = 50 ksi

Span Information

Dysemmetric Beam Span = 0 ft
Composite Section Effective Width = 0 ft
Tributary Width for Load = 0 ft

Precast Slab

Nominal Slab Thickness = 8 in Precast slab weight is outside the expected 60 to 68 psf. Confirm input.
Compressive Strength of Precast Slab Concrete = 5000 psi
Specific Weight of Precast Slab Concrete = 145 lb/ft³
Precast Slab Weight = 0 psf

Grout

Compressive Strength of Grout = 0 psi
Specific Weight of Grout = 0 lb/ft³

Design Requirements (Strength)

Element Slenderness - Top Flange	$w/2t_f =$	
Element Slenderness - Top Flange over Castellations	$L_e/r =$	
Element Slenderness - Web	$(L_e/r)_{max} =$	
Strength - Top Flange to Web Connection	$h_o/t_w =$	
	$l_o =$	
Strength - Shear on Composite Section	$F_{tenc,cf} =$	
	$F_{p,cf-w} =$	
Strength - Moment on Bottom Flange (Transverse Loading)	$V_u =$	
	$t_v V_u =$	
Strength - Moment on Noncomposite Section	$M_{u,bf,2} =$	
	$f_y M_{u,bf,2} =$	
Strength - Moment on Composite Section	$M_{u,nc} =$	
	$f_y M_{u,nc} =$	

Design Requirements (Ductility)

Strain - Bottom Flange Flexural Strain at Ultim:	☒	
	$2\epsilon_{v,bf} =$	
	$\epsilon_{w,bf} =$	

Design Requirements (Serviceability)

Deflection - Live Load	☒	
$D_{LL,allow} = L/$	360	$D_{LL} =$
		$D_{LL,allow} =$
Deflection - Total Load (Net)	☒	
$D_{net,allow} = L/$	240	$D_{DL+LL,net} =$
		$D_{DL+LL,net,allow} =$



Loads

Basic Dead Load (Dysemmetric Beam + Slab + Grout) = #DIV/0! psf
Add'l Composite Dead Load (e.g. Non-Structural Topping) = 0 psf
Unreducible Live Load (e.g. Partition Load) = 0 psf
Basic Occupancy Live Load = 0 psf
Consider Occupancy LL Reduction (IBC 2018 1607.11.1 *) = Yes
Occupancy Live Load Reduction = 0.0%
Reduced Occupancy Live Load = 0.0 psf

* calculations are also valid for earlier versions of IBC

Moments

Basic Dead Load Moment = $\frac{1.4D}{\#DIV/0!}$ $\frac{1.2D + 1.6L}{\#DIV/0!}$ kip-ft
Add'l Composite DL (e.g. Non-Structural Topping) Moment = 0.00 0.00 kip-ft
Unreducible Live Load (e.g. Partition Load) Moment = 0.00 0.00 kip-ft
Occupancy Live Load Moment = 0.00 0.00 kip-ft
Total Moment = #DIV/0! #DIV/0! kip-ft

Shears

Basic Dead Load Shear = $\frac{1.4D}{\#DIV/0!}$ $\frac{1.2D + 1.6L}{\#DIV/0!}$ kips
Add'l Composite DL (e.g. Non-Structural Topping) Shear = 0.00 0.00 kips
Unreducible Live Load (e.g. Partition Load) Shear = 0.00 0.00 kips
Occupancy Live Load Shear = 0.00 0.00 kips
Total Shear = #DIV/0! #DIV/0! kips

Deflections (negative values indicate downward deflection)

(optional) Dysemmetric Beam Camber = 0.00 in
Basic Dead Load Deflection =
Net Self-Weight Deflection including Camber =
Add'l Composite DL (e.g. Non-Structural Topping) Deflection =
Unreducible Live Load (e.g. Partition Load) Deflection =
Occupancy Live Load Deflection =
Total (Net) Deflection due to all loads =

☐ Click here to ignore composite behavior and consider only the noncomposite capacity of the Dysemmetric Beam.

Section Properties *

		Noncomposite	Composite
Elastic (Gross Transformed) Section Properties			
$NA_{bot,DB}$	in		
I_x	in ⁴		
$S_{bot,DB}$	in ³		
$S_{top,DB}$	in ³		
Elastic (Cracked Transformed) Section Properties			
$NA_{bot,DB}$	in		
I_x	in ⁴		
$S_{bot,DB}$	in ³		
$S_{top,DB}$	in ³		
Effective Moment of Inertia (for deflection calculations)			
I_{eff}	in ⁴		
Plastic Section Properties			
$PNA_{bot,DB}$	in		
Z	in ³		
Load Resisted by Each Cross Section		Basic DL (DB/S/G)	Add'l Composite DL Unreducible LL Occupancy LL

Type of Construction Sequence: Unshored

* Elastic and plastic section properties are reported based on transformation of all materials into the steel used in the bottom flange of the Dysemmetric Beam.



Design Example: ANSI/AISC 360-16 [AISC Steel Construction Manual (15th Ed.)]
LRFD Method / Traditional U.S. Units / Standard  / Untopped / Unshored

SAMPLE CALCULATIONS

200mm GIRDER WITH 203mm HOLLOW-CORE US (SI) LRFD

Summary of Design Requirement Checks

In this example, all eleven design requirements were satisfied. A summary of all checks is provided in Table 13.

Design Requirement	Value (Demand)	Limit (Capacity)	Result
Strength			
Element Slenderness - Top Flange	2.54	9.15	OK
Element Slenderness - Top Flange over Castellations	19.40	20.00	OK
Element Slenderness - Web	17.54	49.11	OK
Strength - Top Flange to Web Connection	1095.4 kN	2690.9 kN	OK
Strength - Shear on Composite Section	202.6 kN	301.5 kN	OK
Strength - Moment on Bottom Flange (Transverse Loading)	3.49 kN•m/m	27.14 kN•m/m	OK
Strength- Moment on Noncomposite Section	193.64 kN•m	212.10 kN•m	OK
Strength- Moment on Composite Section	339.37 kN•m	392.66 kN•m	OK
Ductility			
Strain - Bottom Flange Flexural Strain at Ultimate	0.003450	0.010998	OK
Serviceability			
Deflection - Live Load	12.95 mm	18.61 mm	OK
Deflection - Total Load (Net)	17.42 mm	27.92 mm	OK

Table 13 - Summary of Design Checks



Design Example: ANSI/AISC 360-16 [AISC *Steel Construction Manual* (15th Ed.)]
LRFD Method / S.I. Units / Standard  / Untopped / Unshored



Design requirements are in accordance with ANSI/AISC 360-16 specification and associated AISC Steel Construction Manual 15th Edition. Requirements also satisfy earlier editions of the specification (ANSI/AISC 360-10 [AISC 14th Ed.] and (ANSI/AISC 360-05 [AISC 13th Ed.]).

Project Name / Job #

CAUTION: SOME INPUT VALUES HAVE CHANGED. CROSS SECTION ANALYSIS MUST BE RERUN!

ANALYZE

Dysemmetric Beam

Dysemmetric Beam Section = DB200x54
Top Flange Yield Stress = 345 MPa
Parent W Beam Yield Stress = 345 MPa

Span Information

Dysemmetric Beam Span = 8 m
Composite Section Effective Width = 2 m
Tributary Width for Load = 8.6 m

Precast Slab

Nominal Slab Thickness = 203 mm
Compressive Strength of Precast Slab Concrete = 35 MPa
Density of Precast Slab Concrete = 2300 kg/m³
Precast Slab Weight = 3.06 kPa

Grout

Compressive Strength of Grout = 28 MPa
Density of Grout = 2250 kg/m³

Design Requirements (Strength)

Element Slenderness - Top Flange	$w/2t =$
	$l_p =$
Element Slenderness - Top Flange over Castellations	$L_w/r =$
	$(L_w/r)_{max} =$
Element Slenderness - Web	$h_w/t_w =$
	$l_p =$
Strength - Top Flange to Web Connection	$F_{tenc,tf} =$
	$f_{tenc,tf-w} =$
Strength - Shear on Composite Section	$V_u =$
	$f_v V_n =$
Strength - Moment on Bottom Flange (Transverse Loading)	$M_{u,bf,2} =$
	$f_b M_{n,bf,2} =$
Strength - Moment on Noncomposite Section	$M_{u,nc} =$
	$f_b M_{n,nc} =$
Strength - Moment on Composite Section	$M_{u,c} =$
	$f_b M_{n,c} =$

Design Requirements (Ductility)

Strain - Bottom Flange Flexural Strain at U _t	☒
	$2\epsilon_{v,bf} =$
	$\epsilon_{w,bf} =$

Design Requirements (Serviceability)

Deflection - Live Load	☒
$D_{LL,allow} = L/$	360
	$D_{LL} =$
	$D_{LL,allow} =$
Deflection - Total Load (Net)	☒
$D_{net,allow} = L/$	240
	$D_{DL+LL,net} =$
	$D_{DL+LL,net,allow} =$



Loads

Basic Dead Load (Dysemmetric Beam + Slab + Grout) = 3.249 kPa
Add'l Composite Dead Load (e.g. Non-Structural Topping) = 2.2 kPa
Unreducible Live Load (e.g. Partition Load) = 0.25 kPa
Basic Occupancy Live Load = 4.8 kPa
Consider Occupancy LL Reduction (IBC 2018 1607.11.1 *) = Yes
Occupancy Live Load Reduction = 0.0%
Reduced Occupancy Live Load = 4.800 kPa

* calculations are also valid for earlier versions of IBC

Moments

Basic Dead Load Moment = 312.97 268.26 kN-m
Add'l Composite DL (e.g. Non-Structural Topping) Moment = 211.90 181.63 kN-m
Unreducible Live Load (e.g. Partition Load) Moment = 0.00 27.52 kN-m
Occupancy Live Load Moment = 0.00 528.38 kN-m
Total Moment = 524.87 1005.80 kN-m

Shears

Basic Dead Load Shear = 156.48 134.13 kN
Add'l Composite DL (e.g. Non-Structural Topping) Shear = 105.95 90.82 kN
Unreducible Live Load (e.g. Partition Load) Shear = 0.00 13.76 kN
Occupancy Live Load Shear = 0.00 264.19 kN
Total Shear = 262.44 502.90 kN

Deflections (negative values indicate downward deflection)

(optional) Dysemmetric Beam Camber = mm
Basic Dead Load Deflection =
Net Self-Weight Deflection including Camber =
Add'l Composite DL (e.g. Non-Structural Topping) Deflection =
Unreducible Live Load (e.g. Partition Load) Deflection =
Occupancy Live Load Deflection =
Total (Net) Deflection due to all loads =

☐ Click here to ignore composite behavior and consider only the noncomposite capacity of the Dysemmetric Beam.

Section Properties *

	Noncomposite	Composite
Elastic (Gross Transformed) Section Properties		
$N_{A_{bot,DB}}$	mm	
I_p	10 ⁶ mm ⁴	
$S_{bot,DB}$	10 ³ mm ³	
$S_{top,DB}$	10 ³ mm ³	
Elastic (Cracked Transformed) Section Properties		
$N_{A_{bot,DB}}$	mm	---
I_{cr}	10 ⁶ mm ⁴	---
$S_{bot,DB}$	10 ³ mm ³	---
$S_{top,DB}$	10 ³ mm ³	---
Effective Moment of Inertia (for deflection calculations)		
I_{eff}	10 ⁶ mm ⁴	
Plastic Section Properties		
$PNA_{bot,DB}$	mm	
Z	10 ³ mm ³	
Load Resisted by Each Cross Section	Basic DL (DB/S/G)	Add'l Composite DL Unreducible LL Occupancy LL

Type of Construction Sequence: Unshored

* Elastic and plastic section properties are reported based on transformation of all materials into the steel used in the bottom flange of the Dysemmetric Beam.



Design Example: ANSI/AISC 360-16 [AISC Steel Construction Manual (15th Ed.)]
LRFD Method / Traditional U.S. Units / Standard / Untopped / Unshored

SAMPLE CALCULATIONS

200mm GIRDER WITH 203mm HOLLOW-CORE CAN (SI) LSD

Summary of Design Requirement Checks

In this example, all twelve design requirements were satisfied. A summary of all checks is provided in Table 13.

Design Requirement	Value (Demand)	Limit (Capacity)	Result
Strength			
Element Slenderness - Top Flange	1.98	9.15	OK
Element Slenderness - Top Flange over Castellation	15.16	20.00	OK
Element Slenderness - Web	25.76	91.52	OK
Strength - Top Flange to Web Connection	1402.1 kN	2986.3 kN	OK
Strength - Shear on Composite Section	209.5 kN	348.7 kN	OK
Strength - Moment on Bottom Flange (Transverse Loading)	3.36 kN•m/m	27.14 kN•m/m	OK
Strength- Moment on Noncomposite Section	200.58 kN•m	258.83 kN•m	OK
Strength- Moment on Composite Section	376.99 kN•m	382.57 kN•m	OK
Ductility			
Strain - Bottom Flange Flexural Strain at Ultimate	0.003450	0.008851	OK
Serviceability			
Stress - Bottom Flange Flexural Stress at Service	282.50 MPa	345.00 MPa	OK
Deflection - Live Load	12.00 mm	20.00 mm	OK
Deflection - Total Load (Net)	27.21 mm	30.00 mm	OK

Table 13 - Summary of Design Checks



Design Example: CSA S16:19 [CISC Handbook of Steel Construction (12th Ed.)]
S.I. Units / Standard  / Untopped / Unshored

Dysemmetric Beam Calculator Reference Tool V3.4-CAN

(Ref: CISC Handbook of Steel Construction 12th Ed.)

Applicable:
Canada



Design requirements are in accordance with CSA S16:19 specification and associated CISC Handbook of Steel Construction 12th Edition. Requirements also satisfy earlier editions of the specification (CSA S16:14 [CISC 11th Ed.]).

Project Name / Job #

CAUTION: SOME INPUT VALUES HAVE CHANGED. CROSS SECTION ANALYSIS MUST BE RUN!

ANALYZE

Dysemmetric Beam

Dysemmetric Beam Section = DB200x54
Top Flange Yield Stress = 345 MPa
Parent W Beam Yield Stress = 345 MPa

Span Information

Dysemmetric Beam Span = 0 m
Composite Section Effective Width = 0 m
Tributary Width for Load = 0 m

Precast Slab

Precast slab weight is outside the expected
Nominal Slab Thickness = 203 mm 2.87 to 3.26 Confirm input.
Compressive Strength of Precast Slab Concrete = 35 MPa
Density of Precast Slab Concrete = 2300 kg/m³
Precast Slab Weight = 0 kPa

Grout

Compressive Strength of Grout = 0 MPa
Density of Grout = 0 kg/m³

Design Requirements (Strength)

Element Slenderness - Top Flange	$w/2t =$ $(w/2t)_{max} =$
Element Slenderness - Top Flange over Castellations	$L_w/r =$ $(L_w/r)_{max} =$
Element Slenderness - Web	$2d/t_w =$ $(2d/t_w)_{max} =$
Strength - Top Flange to Web Connection	$F_{t,wc} =$ $F_{t,wc} =$
Strength - Shear on Composite Section	$V_r =$ $V_r =$
Strength - Moment on Bottom Flange (Transverse Loading)	$M_{b,lf} =$ $M_{b,lf} =$
Strength - Moment on Noncomposite Section	$M_{r,nc} =$ $M_{r,nc} =$
Strength - Moment on Composite Section	$M_{r,c} =$ $M_{r,c} =$

Design Requirements (Ductility)

Strain - Bottom Flange Flexural Strain at Ultim	☒
$2e_{y,bf} =$	
$e_{p,bf} =$	

Design Requirements (Serviceability)

Stress - Bottom Flange Flexural Stress at Serv	☒
$F_{bot} =$	
$F_{y,bf} =$	
Deflection - Live Load	☒
$D_{s,allow} = L/360$	$D_{s,allow} =$
$D_{s,allow} =$	
Deflection - Total Load (Net)	☒
$D_{net,allow} = L/240$	$D_{net,allow} =$
$D_{net,allow} =$	



Loads

Basic Dead Load (Dysemmetric Beam + Slab + Grout) = #DIV/0! kPa
Add'l Composite Dead Load (e.g. Partitions, Non-Structural Topping) = 0 kPa
Unreducible LL (e.g. Any LL for which LL Reduction May Not Apply) = 0 kPa
Basic Occupancy Live Load = 0 kPa
Consider Occupancy LL Reduction (NBCC 2020 4.1.5.8 *) = None
Occupancy Live Load Reduction = 0.0%
Reduced Occupancy Live Load = 0.000 kPa

* calculations are also valid for earlier versions of NBCC

Moments

Basic Dead Load Moment = 1.4D 1.25D + 1.5L #DIV/0! #DIV/0! kN-m
Add'l Composite DL (e.g. Partitions, Non-Structural Topping) Moment = 0.00 0.00 kN-m
Unreducible Live Load Moment = 0.00 0.00 kN-m
Occupancy Live Load Moment = 0.00 0.00 kN-m
Total Moment = #DIV/0! #DIV/0! kN-m

Shears

Basic Dead Load Shear = 1.4D 1.25D + 1.5L #DIV/0! #DIV/0! kN
Add'l Composite DL (e.g. Partitions, Non-Structural Topping) Shear = 0.00 0.00 kN
Unreducible Live Load Shear = 0.00 0.00 kN
Occupancy Live Load Shear = 0.00 0.00 kN
Total Shear = #DIV/0! #DIV/0! kN

Deflections (negative values indicate downward deflection)

(optional) Dysemmetric Beam Camber = 0.0 mm
Basic Dead Load Deflection =
Net Self-Weight Deflection including Camber =
Add'l Composite DL (e.g. Partitions, Non-Structural Topping) Deflection =
Unreducible Live Load Deflection =
Occupancy Live Load Deflection =
Total (Net) Deflection due to all loads =

☐ Click here to ignore composite behavior and consider only the noncomposite capacity of the Dysemmetric Beam.

Section Properties *

	Noncomposite	Composite
Elastic (Gross Transformed) Section Properties		
$N_{A,bot DB}$	mm	
$I_{x,bot DB}$	10 ⁸ mm ⁴	
$S_{x,bot DB}$	10 ³ mm ³	
$S_{x,top DB}$	10 ³ mm ³	
Elastic (Cracked Transformed) Section Properties		
$N_{A,bot DB}$	mm	
$I_{x,bot DB}$	10 ⁸ mm ⁴	
$S_{x,bot DB}$	10 ³ mm ³	
$S_{x,top DB}$	10 ³ mm ³	
Effective Moment of Inertia (for deflection calculations)		
I_{eff}	10 ⁸ mm ⁴	
Plastic Section Properties		
$PNA_{bot DB}$	mm	
Z	10 ³ mm ³	
Load Resisted by Each Cross Section	Basic DL (DB/S/G)	Add'l Composite DL Unreducible LL Occupancy LL

Type of Construction Sequence: Unshored

* Elastic and plastic section properties are reported based on transformation of all materials into the steel used in the bottom flange of the Dysemmetric Beam.



Design Example: CSA S16:19 [CISC Handbook of Steel Construction (12th Ed.)]
S.I. Units / Standard / Untopped / Unshored

SAMPLE CALCULATIONS

200mm GIRDER WITH 200mm HOLLOW-CORE ANZ (SI) LSD

Summary of Design Requirement Checks

In this example, all twelve design requirements were satisfied. A summary of all checks is provided in Table 13.

Design Requirement	Value (Demand)	Limit (Capacity)	Result
Strength			
Element Slenderness - Top Flange	2.64	8.00	OK
Element Slenderness - Top Flange over Castellations	19.40	20.00	OK
Element Slenderness - Web	15.90	82.00	OK
Strength - Top Flange to Web Connection	1062.5 kN	3325.0 kN	OK
Strength - Bottom Flange to Web Connection	2100.0 kN	7483.9 kN	OK
Strength - Shear on Composite Section	176.6 kN	270.6 kN	OK
Strength - Moment on Bottom Flange (Transverse Loading)	2.60 kN•m/m	31.50 kN•m/m	OK
Strength- Moment on Noncomposite Section	196.03 kN•m	208.44 kN•m	OK
Strength- Moment on Composite Section	331.17 kN•m	406.01 kN•m	OK
Ductility			
Strain - Bottom Flange Flexural Strain at Ultimate	0.003500	0.006740	OK
Serviceability			
Deflection - Imposed Load	14.36 mm	20.83 mm	OK
Deflection - Total Load (Net)	19.74 mm	30.00 mm	OK

Table 13 - Summary of Design Checks



Design Example: AS 4100:2020 or NZS 3404:1997
S.I. Units / Standard  / Untopped / Unshored

Dysemmetric Beam Calculator Reference Tool V3.4- ANZ

(Ref: AS 4100:2020, AS/NZS 1170.0:2002, AS/NZS 1170.1:2002)

Design requirements are in accordance with AS 4100:2020. Structural loading is defined per AS/NZS 1170.0:2002 and AS/NZS 1170.1:2002.



Applicable:
Australia & New
Zealand

Project Location:

Australia

Project Name / Job #

CAUTION: SOME INPUT VALUES HAVE CHANGED. CROSS SECTION ANALYSIS MUST BE RERUN!

ANALYZE

Dysemmetric Beam

Dysemmetric Beam Section = DB200x57a
Top Flange Yield Stress = 340 MPa
Web Yield Stress = 360 MPa
Bottom Flange Yield Stress = 350 MPa

Span Information

Dysemmetric Beam Span = 0 m
Composite Section Effective Width = 0.000 m
Tributary Width for Load = 0 m

Precast Slab

Precast slab weight is outside the expected range
Nominal Slab Thickness = 200 mm 2.87 to 3.26 kPa. Confirm input.
Compressive Strength of Precast Slab Concrete = 35 MPa
Density of Precast Slab Concrete = 2300 kg/m³
Precast Slab Weight = 0 kPa

Grout

Compressive Strength of Grout = 0 MPa
Density of Grout = 0 kg/m³



Loads

Basic Permanent Load (Dysemmetric Beam + Slab + Grout) = #DIV/0! kPa

Add'l Composite Permanent Load (e.g. Partitions, Non-Structural Topping) = 0 kPa
Unreducible Imposed Load (e.g. Any LL for which reduction may not apply) = 0 kPa
Basic Occupancy Imposed Load = 0 kPa
Consider Occupancy Imposed Load Reduction (AS/NZS 1170.1:2002 3.4.2) = Sentence b)
Occupancy Imposed Load Reduction = #DIV/0!
Reduced Occupancy Imposed Load = #DIV/0! kPa

Moments

Basic Permanent Load Moment = 1.35G 1.2G + 1.5Q #DIV/0! #DIV/0! kN-m

Add'l Composite Permanent Load (e.g. Partitions, Non-Structural Topping) Moment = 0.00 0.00 kN-m
Unreducible Imposed Load Moment = 0.00 0.00 kN-m
Occupancy Imposed Load Moment = 0.00 #DIV/0! kN-m
Total Moment = #DIV/0! #DIV/0! kN-m

Shears

Basic Permanent Load Shear = 1.35G 1.2G + 1.5Q #DIV/0! #DIV/0! kN

Add'l Composite Permanent Load (e.g. Partitions, Non-Structural Topping) Shear = 0.00 0.00 kN
Unreducible Imposed Load Shear = 0.00 0.00 kN
Occupancy Imposed Load Shear = 0.00 #DIV/0! kN
Total Shear = #DIV/0! #DIV/0! kN

Deflections (negative values indicate downward deflection)

(optional) Dysemmetric Beam Camber = 0.0 mm
Basic Permanent Load Deflection =

Net Self-Weight Deflection including Camber =
Add'l Composite Permanent (e.g. Partitions, Non-Structural Topping) Deflection =
Unreducible Imposed Load Deflection =
Occupancy Imposed Load Deflection =
Total (Net) Deflection due to all loads =

Design Requirements (Strength)

Element Slenderness - Top Flange	$L_{ef} =$
Element Slenderness - Top Flange over Castellations	$L_{ef}/r =$ $(L_{ef}/r)_{max} =$
Element Slenderness - Web	$L_{ew} =$ $L_{ew}/r =$
Strength - Top Flange to Web Connection	$F_{t,w,f} =$ $IF_{t,w,f} =$
Strength - Bottom Flange to Web Connection	$F_{b,w,f} =$ $IF_{b,w,f} =$
Strength - Shear on Composite Section	$V^* =$ $IV^* =$
Strength - Moment on Bottom Flange (Transverse Loading)	$M^*_{b1,2} =$ $fM^*_{b1,2} =$
Strength - Moment on Noncomposite Section	$M^*_{nc} =$ $fM^*_{nc} =$
Strength - Moment on Composite Section	$M^*_c =$ $fM^*_c =$

Design Requirements (Ductility)

Strain - Bottom Flange Flexural Strain at Ult	☒
$2\epsilon_{w,lf} =$	

Design Requirements (Serviceability)

Deflection - Imposed Load	☒
$D_{Q,allow} = L/360$	$D_Q =$
Deflection - Total Load (Net)	☒
$D_{Q+Q_{net}} = L/250$	$D_{Q+Q_{net}} =$

☐ Click here to ignore composite behavior and consider only the noncomposite capacity of the Dysemmetric Beam.

Section Properties *

	Noncomposite	Composite
Elastic (Gross Transformed) Section Properties		
$NA_{tot,DB}$	mm	
$I_{x,tot}$	10 ⁶ mm ⁴	
$Z_{x,tot,DB}$	10 ³ mm ³	
$Z_{x,tot,DB}$	10 ³ mm ³	
Elastic (Cracked Transformed) Section Properties		
$NA_{cr,DB}$	mm	---
$I_{x,cr}$	10 ⁶ mm ⁴	---
$Z_{x,cr,DB}$	10 ³ mm ³	---
$Z_{x,cr,DB}$	10 ³ mm ³	---
Effective Moment of Inertia (for deflection calculations)		
$I_{e,eff}$	10 ⁶ mm ⁴	
Plastic Section Properties		
$PNA_{tot,DB}$	mm	
S	10 ³ mm ³	
Load Resisted by Each Cross Section	Basic G (DB/SG)	
	Add'l Composite G Unreducible Q Occupancy Q	

Type of Construction Sequence: Unshored

* Elastic and plastic section properties are reported based on transformation of all materials into the steel used in the bottom flange of the Dysemmetric Beam.



Design Example: AS 4100:2020 or NZS 3404:1997
S.I. Units / Standard / Untopped / Unshored

