Load Table Roof Technical Information

General - Presented in the load tables are maximum uniformly distributed specified loads.

ASTM Standard A653 for Galvanized steel & A792 for Galvalume steel

Steel - Conforms to ASTM A653/A653M or A792/A792M. Grade 33/230; Yield stress 33 ksi/230 MPa and tensile stress 45 ksi/310 MPa. Grade 50 /345; Yield stress 50 ksi/345 MPa and tensile stress 65 ksi/450 MPa; Grade 80 /550; Yield stress 80 ksi/550 MPa and tensile stress 82 ksi/565 MPa.

G90(Z275 - metric) for Galvanized & AZ50(AZM150 - metric) for Galvalume

Finishes - A25/ZF75, G90/Z275 or AZ50/AZM150. For heavier metallic coatings, refer to ASTM A653/A653M or A792/A792M.

Load Tables - The following information regarding the determination of the specified wind and snow loads is contained in the 2015 Edition of the National Building Code of Canada (NBCC). Importance factors are applied to both strength (ULS) and serviceability/deflection (SLS) limit state design considerations. A lower load factor for wind of 1.4, instead of 1.5 for live and snow loads is used. This lower load factor for wind somewhat offsets the higher wind loads (1 in 50 year return) that are now listed in the NBCC by geographic location. The importance category of the end use of the building/structure must also be recognized, such as Normal or Low.

All of this will impact how the load tables are to be used. In an effort to help the design professional with the load tables, the information below was taken directly from Division B, Part 4 (Structural Design) of the NBCC.

Specified External Wind Load

$p = I_w \boxed{qC_eC_tC_gC_p}$ [1]

Importance Category	Importance Factor, I_w	
	ULS	SLS
Low	***0.8***	***0.75***
Normal	***1.0***	***0.75***
High	1.15	0.75
Post-Disaster	1.25	0.75

Specified Snow Load

See: *CSSBI B15-17 NBCC 2015 Design Load Criteria for Steel Building Systems* for snow load I_s example & explanation

$S = I_s \boxed{[S_s (C_b C_w C_s C_a) + S_r]}$ [2]

Importance Category	Importance Factor, I_s	
	ULS	SLS
Low	***0.8***	***0.9***
Normal	***1.0***	***0.9***
High	1.15	0.9
Post-Disaster	1.25	0.9

The importance factors, I_w and I_s, have been incorporated in the load tables, as well as the importance category. The parameters in the boxed-in portion of Equations [1] and [2] must be determined by the design professional in accordance with the NBCC.

Loads provided by design professional expressed in metric kPa

Strength - The maximum uniformly distributed specified load based on strength in the load table must be equal to or greater than ***(Specified live load + 0.833 times the specified dead load).*** Where 0.833 = 1.25/1.5. The specified live load can be either due to use and occupancy or snow load. In cases where live load and snow load act together, the load combination factors in the NBCC must be followed.

Serviceability (Deflection) - The maximum uniformly distributed specified load based on deflection in the load table must be equal to or greater than the specified live load. The effective moment of inertia for deflection determination was calculated at an assumed specified live load stress of $0.6F_y$.

EXAMPLE (Use of Load Table)

AWR Roof (Normal Importance Category)

Given: (Imperial units)

(LLF = 1.5 and I_s = 0.9)

From Load Table

~ Panel thickness, t = 0.024 in [24ga]
~ Triple span continuous, L = 4 ft each span
~ Bearing length, N = 3 in
~ L/240 deflection limit
~ Specified Loads
1) Dead load (DL) panel — DL = 1.23 psf [0.06 kPa]
2) Snow Live load (LL) — LL = 40 psf [1.92 kPa]

Profile weight from AWR load table for 24ga = 1.23 psf

The live load is the value of the boxed-in portion of the specified snow load expression [2].

Solution:

Strength "S" LL 40 + (0.833 x DL 1.23) = 41 psf Specified Load

1) Specified load [LL +0.833DL] = 41.0 psf [1.97 kPa]
2) Maximum specified load (from Load Table for Grade 33)
   Is ***49 psf***
   Since ***49 > 41.0 ∴ OK***
3) Check web crippling (N = 3 in)
   a) End reaction = 0.400(41.0)4 = ***66 lb/ft*** (0.400 moment diagram from CSSBI x Specified load from above x 4 ft span)
      (from section property table)
      $P_e = P_{e1} + P_{e2}$ [N/t]$^{1/2}$ N = Bearing length t = steel thickness (gauge)
      → = 45.4 + 11.3[3/0.024]$^{1/2}$ = ***172 lb/ft***
      Since ***172 > 66*** ∴ OK
   b) Interior reaction = 1.10(41.0)4= ***180lb/ft*** (1.10 moment diagram from CSSBI x Specified load from above x 4 ft span)
      (from section property table)
      $P_i = P_{i1} + P_{i2}$ [N/t]$^{1/2}$
      → = 87.6 + 14.9[3/0.024]$^{1/2}$ = ***254lb/ft***
      Since ***254 > 180*** ∴ OK

See Pe & Pi in section properties on AWR load table

Deflection "D"

From table L/180 = ***166 psf*** Tables based on L/180; for L/240 divide 180 by 240 x D from load table
For L/240, multiply 166 by 180/240 = ***125psf***
Since ***125 > 40*** ∴ OK

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WESTMAN STEEL
STATEMENTS IN STEEL™

Imperial | Load Table
AWR Roof Profile

05.28.21

westmansteel.com

1. Based on ASTM A 653 structural steel.
2. Values in row "S" are based on strength.
3. Values in row "D" are based on deflection of 1/180th span.
4. Web crippling not included in strength calculation. See example.
5. Limit States Design principles were used in accordance with CSA Standard S136-16.

Definitions (CSSBI SSF#8)

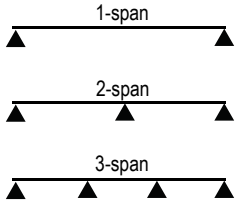
Yield Stress (Strength): Maximum stress that can be applied without permanent deformation of the member. Symbol F_y is used to denote this stress.

Sections Modulus: Property of the cross section which is used to determine the bending stress in the extreme fibre of the section.

Moment of Inertia: Cross-section properties used to determine the deflection caused by flexural stresses.

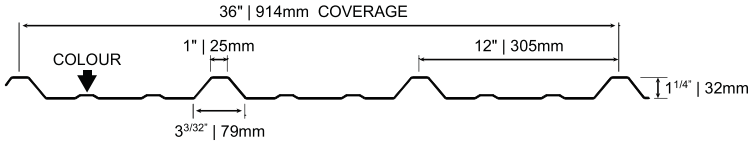
Web Crippling: Localized crushing or failure of the sloped web of a rib due to concentrated load applied between supports or by way of reaction at a support.

Span: Length of a flexural member between supports.



LSD (Limit States Design): Mandated by all Canadian building codes and separates the 'factor of safety' into two parts; The load factor is applied to the specified loads to recognize that loads higher than those anticipated may occur and is independent of the structural material. A resistance factor is applied to the theoretical member strength, or resistance, to recognize that the strength of the member cannot be predicted exactly due to variability in material properties, dimension and workmanship.

LIMIT STATES DESIGN



SECTION PROPERTIES | Per Foot of Width

Base Steel Thickness (in.)	Weight [G90] (psf)	Yield Stress (ksi)	Section Modulus		Deflection Moment of Inertia (in^4)	Specified Web Crippling Data			
			Midspan (in^3)	Support (in^3)		Pe1 End (lb)	Pe2 End (lb)	Pi1 Interior (lb)	Pi2 Interior (lb)
0.0180	0.94	33	0.0406	0.0343	0.0435	24.2	6.04	46.8	7.96
0.0180	0.94	50	0.0385	0.0326	0.0430	36.6	9.15	70.9	12.1
0.0180	0.94	80	0.0376	0.0315	0.0426	43.5	10.9	84.4	14.3
0.0240	1.23	33	0.0571	0.0476	0.0579	45.4	11.3	87.6	14.9
0.0300	1.53	33	0.0710	0.0613	0.0722	73.5	18.4	142	24.1

LLF = 1.50; IMPF = 0.90; NORMAL OCCUPANCY = 1.0

LOAD TABLE | Maximum Uniformly Distributed Specified Loads (psf).

Span Length (ft)		1-Span Base Steel Thickness (in.)					2-Span Base Steel Thickness (in.)					3-Span Base Steel Thickness (in.)				
		0.0180	0.0180	0.0180	0.0240	0.0300	0.0180	0.0180	0.0180	0.0240	0.0300	0.0180	0.0180	0.0180	0.0240	0.0300
Y.S.* (ksi)		33	50	80	33	33	33	50	80	33	33	33	50	80	33	33
2.0	S	134	192	223	188	234	113	163	187	157	202	142	204	234	196	253
2.0	D	527	522	516	701	875	1264	1252	1239	1683	2101	996	986	976	1325	1654
2.5	S	86	123	143	121	150	73	104	120	101	129	91	131	150	126	162
2.5	D	270	267	264	359	448	647	641	634	862	1076	510	505	500	679	847
3.0	S	60	85	99	84	104	50	73	83	70	90	63	91	104	87	112
3.0	D	156	155	153	208	259	375	371	367	499	622	295	292	289	393	490
3.5	S	44	63	73	61	77	37	53	61	51	66	46	67	76	64	83
3.5	D	98	97	96	131	163	236	234	231	314	392	186	184	182	247	309
4.0	S	34	48	56	47	59	28	41	47	39	51	35	51	59	49	63
4.0	D	66	65	65	88	109	158	156	155	210	263	124	123	122	166	207
4.5	S	26	38	44	37	46	22	32	37	31	40	28	40	46	39	50
4.5	D	46	46	45	62	77	111	110	109	148	184	87	87	86	116	145
5.0	S	21	31	36	30	37	18	26	30	25	32	23	33	37	31	40
5.0	D	34	33	33	45	56	81	80	79	108	134	64	63	62	85	106
5.5	S	18	25	30	25	31	15	22	25	21	27	19	27	31	26	33
5.5	D	25	25	25	34	42	61	60	60	81	101	48	47	47	64	80
6.0	S	15	21	25	21	26	13	18	21	17	22	16	23	26	22	28
6.0	D	20	19	19	26	32	47	46	46	62	78	37	37	36	49	61
6.5	S	13	18	21	18	22	11	15	18	15	19	13	19	22	19	24
6.5	D	15	15	15	20	26	37	36	36	49	61	29	29	28	39	48
7.0	S	11	16	18	15	19	9	13	15	13	17	12	17	19	16	21
7.0	D	12	12	12	16	20	29	29	29	39	49	23	23	23	31	39
7.5	S	10	14	16	13	17	8	12	13	11	14	10	15	17	14	18
7.5	D	10	10	10	13	17	24	24	23	32	40	19	19	19	25	31
8.0	S	8	12	14	12	15	7	10	12	10	13	9	13	15	12	16
8.0	D	8	8	8	11	14	20	20	19	26	33	16	15	15	21	26

* Y.S. = Yield Stress

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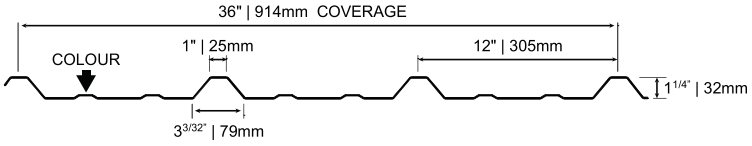
Metric | Load Table
AWR Roof Profile

1. Based on ASTM A 653M structural steel.
2. Values in row “S” are based on strength.
3. Values in row “D” are based on deflection of 1/180th span.
4. Web crippling not included in strength calculation. See example.
5. Limit States Design principles were used in accordance with CSA Standard S136-16.

LIMIT STATES DESIGN



SECTION PROPERTIES | Per Metre of Width

Base Steel Thickness (mm)	Mass [Z275] (kg/m²)	Yield Stress (MPa)	Section Modulus		Deflection Moment of Inertia	Specified Web Crippling Data			
			Midspan (x10³ mm³)	Support (x10³ mm³)	(x10⁶ mm⁴)	Pe1 End (kN)	Pe2 End (kN)	Pi1 Interior (kN)	Pi2 Interior (kN)
0.457	4.59	230	2.18	1.85	0.0594	0.356	0.089	0.691	0.117
0.457	4.59	345	2.07	1.76	0.0588	0.535	0.134	1.04	0.176
0.457	4.59	550	2.02	1.69	0.0582	0.639	0.160	1.24	0.211
0.610	6.02	230	3.07	2.56	0.0790	0.669	0.167	1.29	0.220
0.762	7.46	230	3.82	3.29	0.0987	1.08	0.271	2.09	0.355

LLF = 1.50; IMPF = 0.90; NORMAL OCCUPANCY = 1.0

LOAD TABLE | Maximum Uniformly Distributed Specified Loads (kPa).

Span Length (m)		1-Span Base Steel Thickness (mm)						2-Span Base Steel Thickness (mm)						3-Span Base Steel Thickness (mm)					
		0.457	0.457	0.457	0.610	0.762		0.457	0.457	0.457	0.610	0.762		0.457	0.457	0.457	0.610	0.762	
Y.S.* (MPa)		230	345	550	230	230		230	345	550	230	230		230	345	550	230	230	
1.0	S	2.41	3.42	4.00	3.39	4.21		2.04	2.91	3.35	2.82	3.63		2.55	3.63	4.19	3.53	4.54	
1.0	D	5.71	5.66	5.60	7.61	9.49		13.7	13.6	13.4	18.3	22.8		10.8	10.7	10.6	14.4	18.0	
1.2	S	1.67	2.38	2.78	2.35	2.93		1.41	2.02	2.33	1.96	2.52		1.77	2.52	2.91	2.45	3.15	
1.2	D	3.31	3.27	3.24	4.40	5.49		7.94	7.86	7.77	10.6	13.2		6.25	6.19	6.12	8.32	10.4	
1.4	S	1.23	1.75	2.04	1.73	2.15		1.04	1.48	1.71	1.44	1.85		1.30	1.85	2.14	1.80	2.32	
1.4	D	2.08	2.06	2.04	2.77	3.46		5.00	4.95	4.90	6.65	8.30		3.94	3.90	3.86	5.24	6.54	
1.6	S	0.94	1.34	1.56	1.32	1.65		0.80	1.14	1.31	1.10	1.42		0.99	1.42	1.63	1.38	1.77	
1.6	D	1.39	1.38	1.37	1.86	2.32		3.35	3.31	3.28	4.46	5.56		2.64	2.61	2.58	3.51	4.38	
1.8	S	0.74	1.06	1.23	1.05	1.30		0.63	0.90	1.03	0.87	1.12		0.79	1.12	1.29	1.09	1.40	
1.8	D	0.98	0.97	0.96	1.30	1.63		2.35	2.33	2.30	3.13	3.91		1.85	1.83	1.81	2.47	3.08	
2.0	S	0.60	0.86	1.00	0.85	1.05		0.51	0.73	0.84	0.71	0.91		0.64	0.91	1.05	0.88	1.14	
2.0	D	0.71	0.71	0.70	0.95	1.19		1.71	1.70	1.68	2.28	2.85		1.35	1.34	1.32	1.80	2.24	
2.2	S	0.50	0.71	0.83	0.70	0.87		0.42	0.60	0.69	0.58	0.75		0.53	0.75	0.86	0.73	0.94	
2.2	D	0.54	0.53	0.53	0.71	0.89		1.29	1.28	1.26	1.71	2.14		1.01	1.00	0.99	1.35	1.69	
2.4	S	0.42	0.59	0.69	0.59	0.73		0.35	0.50	0.58	0.49	0.63		0.44	0.63	0.73	0.61	0.79	
2.4	D	0.41	0.41	0.40	0.55	0.69		0.99	0.98	0.97	1.32	1.65		0.78	0.77	0.77	1.04	1.30	
2.6	S	0.36	0.51	0.59	0.50	0.62		0.30	0.43	0.50	0.42	0.54		0.38	0.54	0.62	0.52	0.67	
2.6	D	0.33	0.32	0.32	0.43	0.54		0.78	0.77	0.76	1.04	1.30		0.61	0.61	0.60	0.82	1.02	
2.8	S	0.31	0.44	0.51	0.43	0.54		0.26	0.37	0.43	0.36	0.46		0.32	0.46	0.53	0.45	0.58	
2.8	D	0.26	0.26	0.25	0.35	0.43		0.62	0.62	0.61	0.83	1.04		0.49	0.49	0.48	0.65	0.82	
3.0	S	0.27	0.38	0.44	0.38	0.47		0.23	0.32	0.37	0.31	0.40		0.28	0.40	0.47	0.39	0.50	
3.0	D	0.21	0.21	0.21	0.28	0.35		0.51	0.50	0.50	0.68	0.84		0.40	0.40	0.39	0.53	0.66	

* Y.S. = Yield Stress

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