SIN BEAM TECHNICAL GUIDE

Corrugated Web Steel Beam

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1 GENERAL

1.1 General Description

The SIN beam is a corrugated web welded wide flange steel beam with a corrugated steel web welded to flat steel flanges.

SIN Beams may be used as flexural members such as roof or floor beams, as components subjected to axial loads such as columns, or as combined bending and axial members such as in moment frames or wind columns. The optimal application for the SIN beam is as an alternate to a rolled or welded wide flange shape or a joist or joist girder section with a depth between 300mm and 1800mm.

Traditionally the shear capacity of a thin web steel beam has always been governed by the loss of stability and buckling of the web. Web stiffeners can be used to avoid web bucking but are costly to install. The sinusoidal shape of the SIN beam web prevents buckling, eliminating the need for web stiffeners, and allowing the web steel material to reach is full shear capacity.

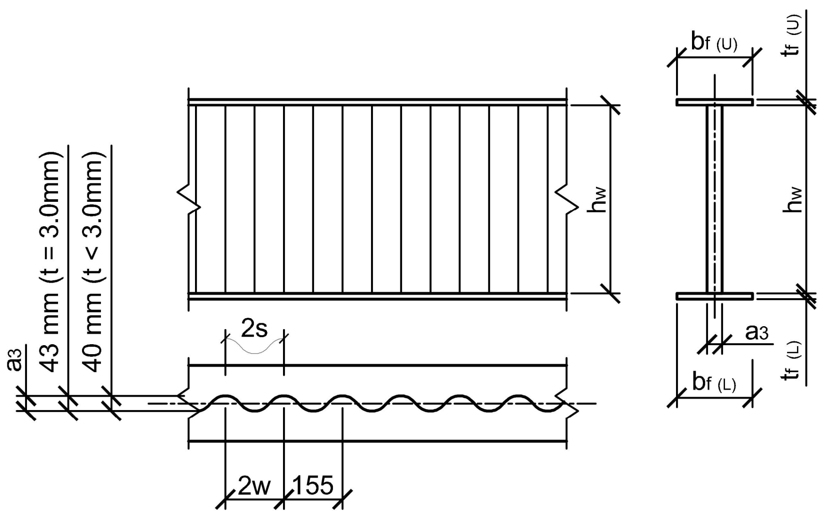


Figure 1: Corrugated Web Steel Beam

1.2 Basis for Calculation

The resistance of the SIN beam to bending, axial and shear forces is described in detail in Section 2 of this guide. The bending and axial capacity of the SIN beam is based on the formula provided in CSA S16-14 “Design of Steel Structures”. The web of the SIN beam is cold formed steel therefore the shear capacity is calculated based on CSA S136-16 “North American Specification for the Design of Cold-Formed Steel Structural Members” .

Due to the sinusoidal shape, the web has a negligible contribution to the axial capacity of the SIN beam flanges. The axial forces in the beam (due to axial load or a bending moment couple) are carried solely by the SIN beam flanges. The corrugated web resists the beam shear forces and stabilizes the flanges. In this way the SIN beam behaves similar to a truss or joist, where the axial and bending forces are carried by the chords (flanges) and the shear forces are carried by the web diagonals (corrugated web).

The SIN beam capacity has been confirmed by a number of experimental results and expert opinions, some of which are included in part 6 of this document.

1.3 Product Range and Designation

Standard SIN beam members are composed of a uniform height corrugated steel web and two flat steel flanges of equal size. Other configurations, including different top and bottom flanges or tapered webs, are also available. The standard configurations and designations are described in this section.

1.3.1 Beam Components

1.3.1.1 Web:

The SIN beam web is manufactured from steel coil material which is cold formed into the corrugated shape. The standard coil widths used to manufacture SIN beam webs are between 13” (333mm) and 59” (1500mm). Each of these coils is available in thickness ranging from 16ga (1.52mm) to 3ga (6.07mm).

The standard coils can be used to create the following standard web heights:

- 13” (333mm)
- 17.32” (440mm)
- 19.7” (500mm)
- 24” (610mm)
- 29.5” (750mm)
- 35.4” (900mm)
- 39.4” (1000mm)
- 48” (1219mm)
- 59” (1500mm)

The web thickness and associated designations are as follows:

- A : 14ga (1.90mm)
- B : 12ga (2.66mm)
- C : 11ga (3.04mm)
- F : 8ga (4.17mm)
- H : 6ga (4.93mm)
- K : 3ga (6.07mm)

The corrugated web follows a sinusoidal shape with a wave length of 155mm and an amplitude of 40mm (43mm for the 3mm web), see figure 1. The web is continuously fillet welded to both beam flanges by robotic welding equipment, on one side of the web.

1.3.1.2 Flange:

The flanges are fabricated of flat stock material or de-stressed coil material with thickness ranging from ¼” (6.4mm) to 1 ½” (38mm) and in widths between 5” (127mm) and 17.7” (450mm). For all standard size SIN beams the ratio of the flange width to thickness has been established to ensure that the beam flange is considered Class 3 or better by CSA S16. A list of standard sizes is included in Part 3 of this document.

Due to the availability of materials flanges ¾” (19mm) and thicker and longer than 40’ (12m) will be spliced with full penetration welds.

1.3.2 Parallel Flange Beam:

The standard SIN beam member is a parallel flange configuration where the web height is constant along the length of the member. Parallel flange SIN beam sections can be manufactured in lengths anywhere between 13’ (4m) and 50’ (15m). For spans longer than 50’ (15m) members must be fabricated in multiple pieces to suit both manufacturing and transportation limitations, once on site members can be connected using bolted moment splices to achieve spans over 50’ (15m).

1.3.2.1 Designation:

The standard designation for a parallel flange SIN beam is:

WT [web_thickness] [web_height] / [flange_width] x [flange_thickness] – [weight]

Example:

WTA 610 / 203x16

→ Top & Bottom Flange Thickness = 16mm [5/8”]

→ Top & Bottom Flange Width = 203mm [8”]

→ Web Height = 610mm [24”]

→ Web thickness A = 14ga (1.90mm)

SIN beam sizes are always shown in metric units.

1.3.2.2 Differing Top and Bottom flanges

Parallel flange beams can be manufactured with different upper and lower flanges. For manufacturing reasons either the flange widths should be the same while the flange thickness may vary or the flange thicknesses should be the same and the flange width may vary by +/- 50mm.

The designation for parallel flange SIN beams with differing upper and lower flanges is:

WT [web_thickness] [web_height] /
[upper_flange_width] x [upper_flange_thickness] /
[lower_flange_width] x [lower_flange_thickness]

Example:
WTB 1000 / 229x16 / 229x10
→ Bottom Flange = 229x10 [9” x 3/8”]
→ Top Flange Width = 229x16 [8” x 5/8”]
→ Web Height = 1000mm [39 3/8”]
→ Web thickness B = 12ga (2.66mm)

1.4 Material

The standard material for both flange and web steel is W350 in accordance with G40.20/G40.21. Other steel grades can also be used but would be considered a special order and would require longer procurement times, minimum order quantities and premium pricing.

1.5 Tolerances

SIN beam members are fabricated to the tolerances given in CSA G40.21 for rolled or welded wide flange steel shapes.

All welding is W47.1 & W59 compliant and done by procedures approved by the Canadian Welding Bureau (CWB). Welding procedures are included in part 5 of this document.

1.6 Corrosion Protection / Painting

SIN beam members are available in any of the following conditions:

1.6.1 Raw Steel

If further fabrication will be required or a special coating will be applied elsewhere the SIN beam member can be shipped as raw steel without any coating.

The corrugated web is welded to the flanges using a continuous fillet weld on one side of the web. It is recommended that a zinc rich primer be applied to the non-welded side of the web in the area where the web contacts the flanges (i.e. opposite the throat of the fillet weld) or other corrosion control measures used to protect this area of the beam.

1.6.2 Standard Shop Paint

The standard SIN beam is coated with a shop primer. Other primers, colors or coatings may be available as a special order.

1.6.3 Hot Dip Galvanized

SIN beam members can easily be Hot Dip Galvanized.

1.7 Quality Monitoring

The manufacturing process is subject to constant and documented internal monitoring. All welding is W47.1 & W59 compliant and done by procedures approved by the Canadian Welding Bureau (CWB).

The quality of the original materials is verified through mill test certificates which are available upon request.

All SIN Beam members are manufactured to meet the same or stricter tolerances than those given for either welded or rolled wide flange steel shapes in CAN / CSA G40.20.

1.8 List of Symbols / Abbreviations

- a_3 – the amplitude of the SIN beam web corrugation (see 1.1)
- A_w – web area
- b_{el} – width of compression element (see 2.1.1)
- $b_{f\,(U)\text{ or }(L)}$ – width of the SIN beam flange (Upper or Lower)
- C_r – Factored compressive resistance
- CWB – Canadian Welding Bureau
- d – overall depth of a SIN beam member
- E – Steel elastic modulus, Young's Modulus (200,000 MPa)
- EN 1993-1-5 – European code for plated steel elements
- F_y – specified minimum steel yield strength
- G40.20/G40.21 – CSA Standard for the requirements for rolled or welded structural steel
- h_w – height of the SIN beam web (i.e. between the flanges)
- I_x, I_y – Moment of inertial about the strong axis / weak axis
- L_u – longest unbraced length where the beam will reach its full moment resistance
- M/D – mass over heated perimeter (kg / m / m) per ULC
- M_r – factored moment resistance
- N – length of bearing for an applied load
- r_x – radius of gyration with respect to the strong axis
- r_y – radius of gyration with respect to the weak axis
- s – unfolded length of half of a single wave of the SIN beam corrugation
- S16 – CSA Standard for Structural Steel
- S136 – CSA Standard for Cold Formed Steel
- S_x – elastic section modulus
- $t_{f\,(U)\text{ or }(L)}$ – thickness of the SIN beam flange (Upper or Lower)
- t_w – SIN beam web thickness
- ULC – Underwriters Laboratory of Canada
- V_r – factored shear resistance
- w – length of half of a single wave of the SIN beam corrugation
- W/D – weight over heated perimeter (lb / ft / ft) per ULC

- W47.1 – CSA Standard for fusion welding
- WTA, WTB, WTC, WTF, WTH, WTK – SIN Beam web thickness designation (see 1.3.1.1)
- Z_x – plastic section modulus
- ν – poisson's ratio
- $\chi_{c,l\ /\ c,g}$ – reduction factor for local and global buckling

1.9 Referenced Standards

- CSA S16-14 – Design of Steel Structures
- CSA S136-16 – North American specification for the design of cold-formed steel structural members
- EN-1993-1-5:2006 – Eurocode 3 – Design of steel structures – Part 1-5: Plated structural elements

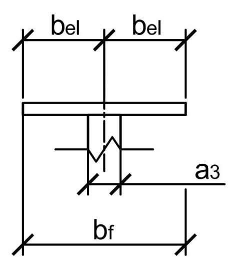
2 TECHNICAL SECTION

2.1 Bending Capacity

2.1.1 Laterally Supported Members

The SIN beam bending moment capacity can be calculated based on the formula given in CSA S16, Clause 13.5. Due to the nature of the corrugated beam web the web material has an insignificant contribution to the bending capacity of the member and should be ignored. Because only the beam flanges contribute to the bending section modulus there is little difference between the elastic (Sx) and plastic (Zx) section modulus therefore the elastic section modulus (Sx) is used for all bending capacity calculations.

S16 requires that for flanges of flexural members the following ratio of flange width to thickness be maintained $\frac{b_{el}}{t} \leq \frac{200}{\sqrt{F_y}}$ (Cl 11.2). Part 5 of this guide includes a technical paper by Guo Yan-lin "Flange Buckling Behavior of the H-Shaped Member with Sinusoidal Webs" which makes recommendations on determining the effective flange width for members similar to the SIN beam. The SIN beam effective flange width calculation is based on $b_{el} = \frac{1}{2}(b_f)$ because this is conservative compared to the Guo Yan-lin recommended formula. SIN beam section properties (published in Part 3 of this document) have been determined to ensure that the flanges meet this criteria and are therefore considered by S16 as Class 1, 2, or 3 in bending.



Standard SIN beam sectional properties and Laterally Supported Moment capacity are given Section 3.1 of this document in both Metric and Imperial units.

2.1.2 Deflection Calculations

Because of the thin and deep web of the SIN beam member, shear deformations will be larger than for conventional rolled wide flange shapes and should be considered for accurate deflection calculations. The beam shear area for each web height and thickness is included in Section 3.3, and can be used to calculate the shear deformation of the SIN beam.

For common beam sizes i.e. less than 36in (914mm) in depth and typical beam spans the shear deflections typical increase the deflection by 5 to 15%. Shear deformation increases linearly with beam length while flexural deformation increases rapidly as a third power to beam length. Therefore, shear deformations are most significant for beams with low span to depth ratios.

Omer Blodgett in “Design of Welded Structures” 1966, section 2.6, provides formula for the calculation of shear deformation of steel beams. Shear deflection is related to the beam loading, span, shear area and modulus of elasticity. Blodgett provides formula for shear deformation due to uniform or point loads on simply supported and cantilever sections. The shear deformation can be added to the beam flexural deformation to determine the total beam deflection. A Shear Deflection calculation, based on Blodgett’s formula, has been included in the sample MathCAD calculations included in section 2.9 of this report.

2.2 Shear Capacity

The SIN beam web material is cold formed steel therefore the shear design of the beam is governed by CSA S136-16.

There are two clauses in CSA S136 for the shear design of beams, clause G covers the design of flat web beams, while clause G4 applies to stiffened beams. The corrugated shape of the SIN beam will stiffen the web of the beam however none of the stiffened cases covered in G4 are directly applicable to the SIN beam configuration. Clause G4.2 covers non-conforming stiffeners and indicates that the capacity of such beams shall be determined by either tests in accordance with Chapter F or rational engineering analysis in accordance with Section A1.2(c).

2.2.1 Shear Capacity – Rational Engineering Analysis

CSA S136 allows for the calculation of shear capacity for a beam with non-conforming stiffeners, such as the SIN beam, to be carried out by rational engineering analysis in accordance with S136 Section A1.2(c). For the calculation of the SIN beam shear capacity we have used a formula developed by research and testing in Europe in the 1990’s which has been adopted into the European code EN1993-1-5:2005 Annex D (This Annex applies specifically to the design of corrugated web steel beams, a copy of it as well as the commentary is included in Section 5 of this guide). The calculated shear capacity is multiplied by a material resistance factor of 0.75 per S136.

The following is a brief look at the Canadian Codes (S136 and S16) and their approach to shear design, followed by a comparison to the European Code and the formula use for the calculation of the shear capacity of the SIN beam members. All of these codes follow similar design approaches, neither S136 nor S16 account for the stiffening effect of the corrugated web. The shear capacity of a steel beam web is governed by either material yielding or by buckling of the beam web.

2.2.1.1 CSA S136 Approach

CSA S136, clause G2 contains formula for the analysis of flat web steel beams. When bucking is not an issue the formula for the shear capacity is given as:

$V_r = \phi V_n$ where $V_n = V_y = 0.6\, A_w F_y$ and this value is reduced to allow for web buckling

2.2.1.2 CSA S16 Approach

CSA S16, clause 13.4 contains formula for the analysis of flat web steel beams. The formula for the shear capacity is given as:

$V_r = \phi A_w F_s$, where $F_s = 0.66\, F_y$ or a reduced value to allow for web buckling

2.2.1.3 EN 1993-1-5:2005 Annex D Approach

The European steel design code EN 1993-1-5:2005 includes Annex D entitled “Plate Girders with Corrugated Webs” which has been developed specifically to design corrugated web steel beams. Annex D provides formula for the shear design of corrugated web beams which accounts for the yielding, local buckling, or global buckling of a corrugated web. The basic shear formula of the European Code and Annex D is:

$$V_r = \chi_c \frac{f_y}{\gamma_{M1}\sqrt{3}}\, h_w\, t_w$$

χ_c is a reduction factor to account for local or global buckling

γ_{M1} is the partial factor equal to 1.0 (we are using a material resistance factor below)

$\frac{f_y}{\sqrt{3}} = .577\, f_y$ is similar and slightly more conservative than $F_s = 0.66\, F_y$ used in S16 or $F_v = 0.60\, F_y$ used in S136

$h_w\, t_w = A_w$ is the area of the web

In the European code material resistance factors are left up to each country and not included in the code formula.

For the calculation of the factored SIN beam shear capacity the above formula has been multiplied by a limit states material resistance factor of $\phi_s = 0.75$ as per the requirements of CSA S136 Clause A1.2(c). Therefore the factored shear capacity for the SIN beam in compliance with CSA S136 is given by:

$$V_r = \phi_s\, \chi_c\, \frac{F_y}{\sqrt{3}}\, h_w\, t_w$$

Where:

$\phi_s = 0.75$ - Material resistance factor based on CSA S136

χ_c - is the lesser of the local or global buckling coefficient $\chi_{c,l}$ or $\chi_{c,g}$

Local Buckling

$$\chi_{c,l} = \frac{1.15}{0.9+\bar{\lambda}_{c,l}} \leq 1.0$$

$$\bar{\lambda}_{c,l} = \sqrt{\frac{F_y}{\tau_{cr,l}\cdot\sqrt{3}}}$$

$$\tau_{cr,l} = \left(5.34 + \frac{a_3 S}{h_w\, t_w}\right)\frac{\pi^2 E}{12(1-\nu^2)}\left(\frac{t_w}{s}\right)^2$$

a_3 - Web amplitude

S - unfolded length of one half wave

E – Young's modulus

ν – Poisson's Ratio

Global Buckling

$$\chi_{c,g} = \frac{1.5}{0.5+\bar{\lambda}_{c,g}{}^2} \leq 1.0$$

$$\bar{\lambda}_{c,g} = \sqrt{\frac{F_y}{\tau_{cr,g} \cdot \sqrt{3}}}$$

$$\tau_{cr,g} = \frac{32.4}{t_w\ h_w{}^2} \sqrt[4]{D_x\ D_z{}^3}$$

$$D_x = \frac{E\ t^3}{12(1-\nu^2)} \frac{w}{s}$$

$$D_z = \frac{E\ I_z}{w}$$

w - length of one half wave

I_z - second moment of area of one corrugation of length w

F_y – Web steel yield strength

$h_w\ t_w$ - The height and thickness of the corrugated steel web

2.2.2 Shear Capacity – Load Testing

S136, Section K provides an outline of the testing regime required to determine member capacities based on load testing alone. This process would require a minimum of 3 load tests for every possible web thickness and depth, which would be a long and restrictive process as SIN beam members can be produced in a range of sizes and web thicknesses.

Steelcon has conducted shear load testing, based on S136 Section K 2.1.1(a), of a selection of SIN beam members to ensure that the shear formula outlined above is conservative. A report of the shear load testing is included in section 6 of this guide. The shear load testing has shown that the formula are conservative, but not overly conservative for the calculation of the SIN beam shear capacity.

2.2.3 Combined Shear and Moment

Both CSA S16 and S136 include clauses to limit combined bending and shear. This is not required for the SIN beam design as any contribution of the web material to the flexural capacity is ignored.

2.2.4 Web to Flange welds

The corrugated SIN beam web is welded to the top and bottom flange of each beam with a continuous fillet weld on one side of the web. The welding is completed per the CWB welding procedures including in Part 5 of this Guide.

Per Clause 14.2.3 of S16 the weld between the flange and the web has been proportioned to exceed the maximum shear for each web thickness. Below is a table of the SIN beam web thicknesses with the corresponding maximum shear forces and weld capacities.

SIN Designation	Web Thickness (mm)	Max Shear (kN / mm)	Weld size (mm)	Weld Capacity (kN/mm)	Ratio of Weld / Shear
WTA	1.90	0.287	3	0.533	1.86
WTB	2.66	0.403	4	0.711	1.76
WTC	3.04	0.461	4	0.711	1.54
WTF	4.18	0.633	5	0.889	1.40
WTH	4.94	0.749	5	0.889	1.19
WTK	6.07	0.920	6	1.067	1.16

As indicated in the above table the weld of the web to the flange is designed to always exceed the shear forces transmitted between the web and flange. If additional loads are transmitted between the flange and the web, such as a hanger connected to the bottom flange in an area with high shear forces the weld will need to be reviewed or alternate methods used to transfer the loads into the web.

2.3 Axial Capacity

The axial capacity of a SIN beam section can be determined by formula contained in S16 clause 13.3, or 13.8 for combined compression and bending. Similar to the flexural resistance the axial resistance is provided solely by the steel area of the flanges (neglecting any contribution of the web). All of the parameters required to calculate the axial capacity of the SIN beam members are indicated in the table 3.1. Table 3.5 includes the compressive resistance of SIN beam members for various unsupported lengths calculated based on S16 clause 13.3.

2.4 Web Crippling

Testing has been done in Europe that indicates that the standard European code formula given in EN1993-1-8:2005 clause 6.2.6.2 for web crippling of wide flange shapes is conservative for the calculation of the bearing resistance for SIN beam members, $F_{c,wc,Rd} = \frac{\omega \cdot k_{wc} \cdot b_{eff,c,wc} \cdot t_{wc} \cdot f_{y,wc}}{\gamma_{M0}}$ where $b_{eff,c,wc} = t_{fb} + 2\sqrt{2}a_b + 5(t_{fc} + s)$. A number of the variables in these formulas can be eliminated because they are equal to unity or zero and the formula rearranged using the common S16 variable names to read $B_r = t_w(N + 5t_f)F_y$. This formula is more conservative than the S16 formula in 14.3.2 for interior loads and therefore used in the calculation of the SIN beam web crippling calculation. Table 3.6 summarizes the web crippling capacity for common SIN beam sizes using this formula and applying a material resistance factor of ϕ_{bi} = 0.80.

When the bearing resistance of the web is exceeded, or for any concentrated loads located at the end of a SIN beam member bearing stiffeners shall be used.

2.5 Fatigue

The SIN beam is a welded wide flange section with a corrugated steel web. It is not recommended to use the SIN beam for sections such as crane girders which will be subject to significant cyclic / fatigue loads and as well as high point loads.

2.6 Temperature Effects

When exposed to temperature changes SIN beam members will expand and contract as any steel beams. When SIN beams are used in larger building structures or are expected to be exposed to significant temperature changes proper detailing (expansion joints etc) must be included in the design of the building. Connection detailing must also consider that the axial loads in SIN beam members, including those developed by temperature effects, are carried primarily by the beam flanges and the connections must be detailed appropriately.

2.7 Sectional Properties Calculation

Part 3 of this document contains member sectional properties for standard size SIN beams. All of these sections are based on constant depth beams with equal top and bottom flanges. The following formula were used to calculate the SIN beam properties:

- $Area = 2 \cdot b_f \cdot t_f$ (Area of Flanges for Axial load or bending)
- $Shear\ Area = h_w t_w \frac{w}{s}$ (Area to be used for shear distortion calculations)
- $Overall\ Depth\ d = h_w + 2 * t_f$
- $I_x = 2\left[\frac{1}{12} \cdot b_f \cdot {t_f}^3 + b_f \cdot t_f \cdot (\frac{1}{2} h_w + \frac{1}{2} t_f)^2\right]$ or $I_x = \frac{1}{12} \cdot b_f \cdot d^3 - \frac{1}{12} \cdot b_f \cdot {h_w}^3$
- $S_x = \frac{I_x}{\frac{1}{2} d}$
- $I_y = \frac{1}{12} \cdot 2 \cdot t_f \cdot {b_f}^3$
- $S_y = \frac{I_y}{\frac{1}{2} b_f}$
- $M_r = \emptyset \cdot S_x F_y$ (CSA S16 Cl 13.5)

2.8 Sample Calculation

Attached is a sample calculation for the bending, shear capacity and deflection (including shear deformations) of a typical SIN beam flexural member using PTC Mathcad. A digital (editable) copy of this calculation is available on request, and PTC Mathcad Express can be downloaded for free from www.ptc.com.

Sample Calculation for a SIN Beam WTA 750/230x9.5

Beam Properties

$h_w := 762\ mm$

$b_{flange} := 203\ mm$

$t_{web} := 1.897\ mm$

$t_{flange} := 9.5\ mm$

$a_{web} := 40\ mm$

Web Thickness
WTA = 1.897 mm
WTB = 2.657 mm
WTC = 3.038 mm
WTF = 4.176 mm
WTH = 4.935 mm
WTK = 6.073 mm

Material Properties

$F_{y\_Flange} := 350\ MPa$

$F_{y\_Web} := 350\ MPa$

$\phi_s := 0.9$

$\nu := 0.3$ Poissons Ratio

$E := 200\ GPa$

$G := 77\ GPa$

$\phi_{s.shear} := 0.75$

Calculated Section Properties

$$A := 2 \cdot b_{flange} \cdot t_{flange} = 3857\ mm^2$$

$$d := h_w + 2 \cdot t_{flange} = 781\ mm$$

$$I_x := \frac{1}{12} \cdot b_{flange} \cdot d^3 - \frac{1}{12} \cdot b_{flange} \cdot h_w{}^3 = \left(573.962 \cdot 10^6\right)\ mm^4$$

$$S_x := \frac{I_x}{\frac{1}{2} \cdot d} = \left(1.47 \cdot 10^6\right)\ mm^3$$

$$Z_x := \frac{I_x}{\frac{1}{2} \cdot h_w + \frac{1}{2}\ t_{flange}} = \left(1.488 \cdot 10^6\right)\ mm^3$$

$$I_y := \frac{1}{12} \cdot b_{flange}{}^3 \cdot d - \frac{1}{12} \cdot b_{flange}{}^3 \cdot h_w = \left(13.245 \cdot 10^6\right)\ mm^4$$

$$S_y := \frac{I_y}{\frac{1}{2} \cdot b_{flange}} = \left(130.495 \cdot 10^3\right)\ mm^3$$

CSA S16 - Moment Calculation

Flange Classification per Clause 11.2

$$\frac{\frac{1}{2} b_{flange}}{t_{flange}} \cdot \sqrt[2]{\frac{F_{y\_Flange}}{1\ MPa}} = 199.883$$

< 145 = Class 1
< 170 = Class 2
< 200 = Class 3

Moment Capacity per 13.5 - Laterally Supported

$$M_r := \phi_s \cdot F_{y\_Flange} \cdot S_x = 462.991\ kN \cdot m$$

$$M_r := \phi_s \cdot F_{y\_Flange} \cdot Z_x = 468.693\ kN \cdot m$$

Elastic Capacity is generally used because it is very close to the plastic capacity

Shear Capacity - Per CSA S136 / EN 1993-1-5:2006 Annex D clause 2.2

$t_w := t_{web}$ $a_3 := a_{web}$ $f_{yw} := F_{y\_Web}$ $w := \frac{155}{2}\ mm$

$\gamma_{m1} := 1.0$ Partial Factor EN1993-1-1:2005 cl 6.1

$$s := \frac{1}{2} \int_0^{2\,w} \sqrt{1 + \left(\frac{a_3 \cdot \pi}{2\,w} \cdot \sin\left(\frac{2 \cdot \pi \cdot x}{2\,w}\right)\right)^2}\, dx = 88.985\ mm \qquad 2\,s = 177.97\ mm$$

$$I_z := \frac{1}{2} \int_0^{2\,w} \left(\frac{1}{12} \cdot t_w^{\ 3} + t_w \cdot \left(\frac{a_3}{2} \cdot \sin\left(\frac{2 \cdot \pi \cdot x}{2\,w}\right)\right)^2\right) dx = 2.945\ cm^4$$

$$\tau_{cr.l} := \left(5.34 + \frac{a_{web} \cdot s}{h_w \cdot t_w}\right) \cdot \frac{\pi^2 \cdot E}{12 \cdot \left(1 - \nu^2\right)} \cdot \left(\frac{t_w}{s}\right)^2 = \left(640.964 \cdot 10^3\right)\ kPa$$

$$\lambda_{c.l} := \sqrt{\frac{f_{yw}}{\tau_{cr.l} \cdot \sqrt{3}}} = 561.483 \cdot 10^{-3}$$

$$\chi_{c.l} := min\left(1, \frac{1.15}{0.9 + \lambda_{c.l}}\right) = 786.872 \cdot 10^{-3}$$

$$D_z := \frac{E \cdot I_z}{w} = 75.994\ kN \cdot m$$

$$D_x := \frac{E \cdot t_w^{\ 3}}{12 \cdot \left(1 - \nu^2\right)} \cdot \frac{w}{s} = \left(108.891 \cdot 10^{-3}\right)\ kN \cdot m$$

$$\tau_{cr.g} := \frac{32.4}{t_w \cdot h_w^{\ 2}} \cdot \sqrt[4]{D_x \cdot D_z^{\ 3}} = \left(434.91 \cdot 10^3\right)\ kPa$$

$$\lambda_{c.g} := \sqrt{\frac{f_{yw}}{\tau_{cr.g} \cdot \sqrt{3}}} = 681.638 \cdot 10^{-3}$$

$$\chi_{c.g} := min\left(\frac{1.5}{0.5 + \lambda_{c.g}^{\ 2}}, 1\right) = 1$$

$$\chi_c := min\left(\chi_{c.l}, \chi_{c.g}\right) = 786.872 \cdot 10^{-3}$$

$$V := \chi_c \cdot \frac{f_{yw}}{\gamma_{m1} \cdot \sqrt{3}} \cdot h_w \cdot t_w = 229.844\ kN$$

$$V_r := \phi_{s.shear} \cdot V = 172.383\ kN$$

Deflection Calculation - Including Shear Deformations

WTA 750 / 203 x 9.5
SPAN = 12m
UDL = 4.8 kPa X 6m

$w_{load} := 4.8\ kPa \cdot 6\ m$ $\quad l := 12000\ mm$

$$\Delta_{flexure} := \frac{5}{384} \cdot \frac{w_{load} \cdot l^4}{E \cdot I_x} = 67.74\ mm$$

$G := 77\ GPa$ $\quad b := b_{flange} = 203\ mm$

$d_1 := h_w = 762\ mm$ $\quad t := t_{web} \cdot \frac{w}{s} = 1.652\ mm$

$$\alpha := A \cdot \frac{b \cdot d^2 - b \cdot {d_1}^2 + t \cdot {d_1}^2}{8 \cdot I_x \cdot t}$$

$$\Delta_{shear} := \frac{w_{load} \cdot l^2 \cdot \alpha}{8 \cdot A \cdot G} = 6.133\ mm$$

$$\Delta_{total} := \Delta_{flexure} + \Delta_{shear} = 73.873\ mm$$

$$\frac{\Delta_{shear}}{\Delta_{total}} = 83.021 \cdot 10^{-3}$$

SHEAR DEFORMATION IS
8.3 % OF TOTAL DEFLECTION

For A Point Load

WTA 750 / 203 x 9.5
SPAN = 10m
POINT LOAD = 200kN @ MID SPAN

$P := 200\ kN$ $\quad L := 10000\ mm$

$$\Delta_{flexure} := \frac{P \cdot L^3}{48 \cdot E \cdot I_x} = 36.297\ mm$$

$$\Delta_{shear} := \frac{P \cdot L \cdot \alpha}{4 \cdot A \cdot G} = 5.915\ mm$$

$$\Delta_{total} := \Delta_{flexure} + \Delta_{shear} = 42.213\ mm$$

$$\frac{\Delta_{shear}}{\Delta_{total}} = 140.13 \cdot 10^{-3}$$

SHEAR DEFORMATION IS
14.0 % OF TOTAL DEFLECTION

SHEAR DEFORMATION CALCUALTIONS ARE BASED ON SHEAR DEFORMATION FORMULA FROM "DESING OF WELDED STRUCTURES" BY OMER BLODGETT IN CHAPER 2.6 "SHEAR DEFLECTION OF BEAMS"

3 TABLES

3.1 Common SIN Beam Sizes

1 Page – Combined Metric and Imperial

3.2 Bending Capacity – Laterally Supported

10 Pages – Metric

10 Pages - Imperial

3.3 RESERVED

3.4 Shear Capacity

2 Pages – Metric

2 Pages – Imperial

3.5 Axial Capacity

9 Pages – Metric

9 Pages – Imperial

3.6 Concentrated Load / Web Crippling Capacity

2 Pages – Metric

2 Pages – Imperial

3.7 M/D and W/D ratios for ULC Calculation

9 pages – Combined Metric and Imperial

Common SIN Beam Sizes

2020-10-01

Web Thicknesses			
	ga	mm	in
WTA	14	1.897	0.075
WTB	12	2.657	0.105
WTC	11	3.038	0.120
WTF	8	4.176	0.164
WTH	6	4.935	0.194
WTK	3	6.073	0.239

Web Height	
mm	in
333	13.11
440	17.32
500	19.69
610	24.02
750	29.53
900	35.43
1000	39.37
1219	47.99
1500	59.06

Flange Size				
t (mm)	W (mm)	t (in)	W (in)	A (sq in)
6	127	1/4	5	1.25
6	152	1/4	6	1.50
8	152	5/16	6	1.88
10	152	3/8	6	2.25
10	178	3/8	7	2.63
13	152	1/2	6	3.00
13	178	1/2	7	3.50
13	203	1/2	8	4.00
16	203	5/8	8	5.00
19	152	3/4	6	4.50
19	203	3/4	8	6.00
19	254	3/4	10	7.50
25	203	1	8	8.00
25	254	1	10	10.00
25	279	1	11	11.00
25	305	1	12	12.00
25	330	1	13	13.00
25	356	1	14	14.00
25	406	1	16	16.00
32	254	1 1/4	10	12.50
32	305	1 1/4	12	15.00
32	356	1 1/4	14	17.50
32	406	1 1/4	16	20.00
32	450	1 1/4	17.71654	22.15

Greyed out sizes are not as commonly used

Designation is WebThickness WebHeight / FlangeW x FlangeT

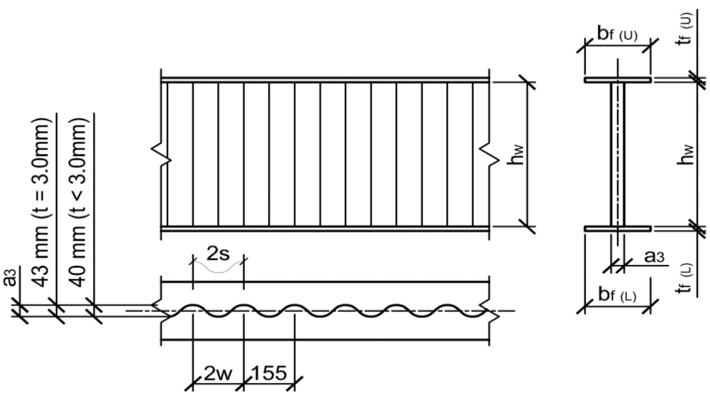
i.e.WTA610/178x10

- 1.89mm thick web
- 610mm tall web
- 178 x 10 mm flanges

Each SIN beam can be any combination of Web Thickness, WebHeight and FlangeSize

The length of the sin wave is constantly 155mm

The magnitude of the sin wave is 40mm for the WTA, and WTB but 43mm for the WTC and higher



Web Thicknesses (for weight calculation)			
	actual	mm	in
WTA	1.897	2.307	0.091
WTB	2.657	3.231	0.127
WTC	3.038	3.694	0.145
WTF	4.176	5.078	0.200
WTH	4.935	6.001	0.236
WTK	6.073	7.385	0.291

For Tekla Modeling with a flat web beam use an increased web thickness to achive the proper beam weigth

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SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties, Strong Axis I_x 10^6 mm^4	Section Properties, Strong Axis S_x 10^3 mm^3	Section Properties, Weak Axis I_y 10^6 mm^4	Section Properties, Weak Axis S_y 10^3 mm^3	Factored Moment Resistance M_r kN m	Factored Moment Resistance L_u mm	Beam Weight WTA kg / m	Beam Weight WTB kg / m	Beam Weight WTC kg / m	Beam Weight WTF kg / m	Beam Weight WTH kg / m	Beam Weight WTK kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
333	127	x	6	1612.9	346	46.44	268.7	2.17	34.1	84.6	1910	18.5	20.8	21.9	25.4	27.7	31.2
	152	x	6 **	1736.1	346	49.99	289.2	2.70	39.6	91.1	2060	21.0	23.3	24.5	28.0	30.3	33.8
	152	x	8	2419.4	349	70.32	403.1	4.68	61.5	127.0	2320	24.8	27.1	28.3	31.8	34.1	37.6
	152	x	10	2903.2	352	85.18	483.9	5.62	73.7	152.4	2340	28.6	30.9	32.1	35.6	37.9	41.3
	178	x		3387.1	352	99.37	564.5	8.92	100.4	177.8	2740	32.4	34.7	35.9	39.3	41.7	45.1
	152	x	13	3871	358	115.71	645.7	7.49	98.3	203.4	2400	36.2	38.5	39.7	43.1	45.5	48.9
	178	x		4516.1	358	134.99	753.3	11.90	133.8	237.3	2800	41.2	43.6	44.7	48.2	50.5	54.0
	203	x		5161.3	358	154.27	860.9	17.76	174.8	271.2	3210	46.3	48.6	49.8	53.3	55.6	59.1
	152	x	19	5806.4	371	180.09	970.6	11.24	147.5	305.7	2560	51.4	53.7	54.9	58.3	60.7	64.1
	203	x	16	6451.6	365	196.45	1077.2	22.20	218.5	339.3	3300	56.4	58.8	59.9	63.4	65.7	69.2
	203	x	19	7741.9	371	240.12	1294.1	26.64	262.2	407.6	3420	66.6	68.9	70.1	73.5	75.9	79.3
	254	x		9677.4	371	300.14	1617.6	52.03	409.7	509.5	4280	81.8	84.1	85.3	88.7	91.0	94.5
	203	x	25	10323	384	332.04	1730.3	35.52	349.6	545.0	3720	86.8	89.2	90.3	93.8	96.1	99.6
	254	x		12903	384	415.05	2162.8	69.37	546.2	681.3	4650	107.1	109.4	110.6	114.1	116.4	119.8
	279	x		14194	384	456.55	2379.1	92.33	660.9	749.4	5110	117.2	119.5	120.7	124.2	126.5	130.0
	305	x		15484	384	498.06	2595.4	119.87	786.6	817.6	5580	127.3	129.7	130.8	134.3	136.6	140.1
	254	x	32	16129	397	537.82	2712.8	86.71	682.8	854.5	5110	132.4	134.7	135.9	139.4	141.7	145.2
	330	x	25	16774	384	539.56	2811.7	152.41	923.1	885.7	6040	137.5	139.8	141.0	144.4	146.8	150.2
	356	x		18064	384	581.07	3028.0	190.36	1070.6	953.8	6510	147.6	149.9	151.1	154.6	156.9	160.4
	305	x	32	19355	397	645.38	3255.4	149.84	983.2	1025.4	6130	157.7	160.1	161.2	164.7	167.0	170.5
	406	x	25	20645	384	664.08	3460.5	284.15	1398.4	1090.1	7440	167.9	170.2	171.3	174.8	177.1	180.6
	356	x	32	22581	397	752.94	3797.9	237.95	1338.3	1196.4	7160	183.1	185.4	186.5	190.0	192.3	195.8
	406	x		25806	397	860.51	4340.5	355.18	1748.0	1367.3	8180	208.4	210.7	211.9	215.3	217.7	221.1
	450	x		28575	397	952.82	4806.2	482.20	2143.1	1513.9	9060	230.1	232.4	233.6	237.1	239.4	242.9

Factored Shear Resistance Vr (kN) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
333	80.2	121.8	143.5	210.0	249.1	306.5

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3			Factored Moment Resistance M_r kN m	L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
440	127	x	6	1612.9	453	80.34	354.9	2.17	34.1			111.8	1900	20.3	23.4	24.9	29.5	32.6	37.2
	152	x	6 **	1736.1	453	86.48	382.0	2.70	39.6			120.3	2050	22.9	25.9	27.5	32.1	35.1	39.7
	152	x	8	2419.4	456	121.37	532.5	4.68	61.5			167.7	2290	26.7	29.7	31.3	35.9	38.9	43.5
	152	x	10	2903.2	459	146.69	639.1	5.62	73.7			201.3	2310	30.5	33.5	35.1	39.7	42.7	47.3
	178	x		3387.1	459	171.14	745.6	8.92	100.4			234.9	2700	34.2	37.3	38.9	43.4	46.5	51.1
	152	x	13	3871	465	198.38	852.5	7.49	98.3			268.5	2350	38.0	41.1	42.7	47.2	50.3	54.9
	178	x		4516.1	465	231.44	994.6	11.90	133.8			313.3	2740	43.1	46.2	47.7	52.3	55.4	60.0
	203	x		5161.3	465	264.50	1136.7	17.76	174.8			358.1	3130	48.2	51.2	52.8	57.4	60.4	65.0
	152	x	19	5806.4	478	306.07	1280.4	11.24	147.5			403.3	2440	53.2	56.3	57.8	62.4	65.5	70.1
	203	x	16	6451.6	472	335.33	1421.6	22.20	218.5			447.8	3190	58.3	61.4	62.9	67.5	70.6	75.2
	203	x	19	7741.9	478	408.09	1707.1	26.64	262.2			537.7	3260	68.4	71.5	73.0	77.6	80.7	85.3
	254	x		9677.4	478	510.11	2133.9	52.03	409.7			672.2	4070	83.6	86.7	88.2	92.8	95.9	100.5
	203	x	25	10323	491	559.51	2280.0	35.52	349.6			718.2	3430	88.7	91.8	93.3	97.9	101.0	105.6
	254	x		12903	491	699.39	2850.0	69.37	546.2			897.8	4290	109.0	112.0	113.6	118.2	121.2	125.8
	279	x		14194	491	769.33	3135.0	92.33	660.9			987.5	4710	119.1	122.1	123.7	128.3	131.3	135.9
	305	x		15484	491	839.27	3420.0	119.87	786.6			1077.3	5140	129.2	132.3	133.8	138.4	141.5	146.1
	254	x	32	16129	504	898.72	3569.9	86.71	682.8			1124.5	4560	134.3	137.3	138.9	143.5	146.5	151.1
	330	x	25	16774	491	909.21	3705.0	152.41	923.1			1167.1	5570	139.3	142.4	143.9	148.5	151.6	156.2
	356	x		18064	491	979.15	3990.0	190.36	1070.6			1256.9	6000	149.5	152.5	154.1	158.7	161.7	166.3
	305	x	32	19355	504	1078.47	4283.9	149.84	983.2			1349.4	5470	159.6	162.7	164.2	168.8	171.9	176.5
	406	x	25	20645	491	1119.03	4560.0	284.15	1398.4			1436.4	6860	169.7	172.8	174.3	178.9	182.0	186.6
	356	x	32	22581	504	1258.21	4997.9	237.95	1338.3			1574.3	6380	184.9	188.0	189.5	194.1	197.2	201.8
	406	x		25806	504	1437.96	5711.9	355.18	1748.0			1799.2	7290	210.2	213.3	214.8	219.4	222.5	227.1
	450	x		28575	504	1592.23	6324.6	482.20	2143.1			1992.3	8080	232.0	235.0	236.6	241.2	244.2	248.8

Factored Shear Resistance Vr (kN) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
440	103.5	158.3	186.8	274.7	329.1	405.0

Steelcon

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3	Factored Moment Resistance M_r kN m	Factored Moment Resistance L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	b	c	d	e	f	g	h	i	j	m	n	p	q	r	s	t	u
500	127	x	6	1612.9	513	103.39	403.3	2.17	34.1	127.0	1900	21.4	24.9	26.6	31.8	35.3	40.5
	152	x	6 **	1736.1	513	111.29	434.1	2.70	39.6	136.7	2040	23.9	27.4	29.1	34.4	37.8	43.1
	152	x	8	2419.4	516	156.06	605.0	4.68	61.5	190.6	2290	27.7	31.2	32.9	38.2	41.6	46.9
	152	x	10	2903.2	519	188.45	726.1	5.62	73.7	228.7	2300	31.5	35.0	36.7	42.0	45.4	50.7
	178	x		3387.1	519	219.86	847.2	8.92	100.4	266.9	2680	35.3	38.8	40.5	45.7	49.2	54.5
	152	x	13	3871	525	254.43	968.5	7.49	98.3	305.1	2330	39.1	42.6	44.3	49.5	53.0	58.3
	178	x		4516.1	525	296.84	1130.0	11.90	133.8	355.9	2720	44.2	47.6	49.4	54.6	58.1	63.3
	203	x		5161.3	525	339.24	1291.4	17.76	174.8	406.8	3100	49.2	52.7	54.5	59.7	63.2	68.4
	152	x	19	5806.4	538	391.26	1454.2	11.24	147.5	458.1	2400	54.3	57.8	59.5	64.7	68.2	73.4
	203	x	16	6451.6	532	429.37	1614.9	22.20	218.5	508.7	3150	59.4	62.8	64.6	69.8	73.3	78.5
	203	x	19	7741.9	538	521.68	1939.0	26.64	262.2	610.8	3200	69.5	73.0	74.7	79.9	83.4	88.6
	254	x		9677.4	538	652.10	2423.7	52.03	409.7	763.5	4010	84.7	88.2	89.9	95.1	98.6	103.8
	203	x	25	10323	551	712.93	2588.7	35.52	349.6	815.4	3340	89.7	93.2	95.0	100.2	103.7	108.9
	254	x		12903	551	891.16	3235.9	69.37	546.2	1019.3	4180	110.0	113.5	115.2	120.4	123.9	129.2
	279	x		14194	551	980.28	3559.5	92.33	660.9	1121.2	4590	120.1	123.6	125.4	130.6	134.1	139.3
	305	x		15484	551	1069.39	3883.1	119.87	786.6	1223.2	5010	130.3	133.7	135.5	140.7	144.2	149.4
	254	x	32	16129	564	1141.51	4051.5	86.71	682.8	1276.2	4390	135.3	138.8	140.6	145.8	149.3	154.5
	330	x	25	16774	551	1158.51	4206.6	152.41	923.1	1325.1	5430	140.4	143.9	145.6	150.8	154.3	159.5
	356	x		18064	551	1247.62	4530.2	190.36	1070.6	1427.0	5850	150.5	154.0	155.7	161.0	164.5	169.7
	305	x	32	19355	564	1369.81	4861.8	149.84	983.2	1531.5	5270	160.6	164.1	165.9	171.1	174.6	179.8
	406	x	25	20645	551	1425.86	5177.4	284.15	1398.4	1630.9	6680	170.8	174.3	176.0	181.2	184.7	189.9
	356	x	32	22581	564	1598.11	5672.1	237.95	1338.3	1786.7	6140	186.0	189.4	191.2	196.4	199.9	205.1
	406	x		25806	564	1826.41	6482.4	355.18	1748.0	2041.9	7020	211.3	214.8	216.5	221.7	225.2	230.4
	450	x		28575	564	2022.35	7177.8	482.20	2143.1	2261.0	7780	233.0	236.5	238.3	243.5	247.0	252.2

Factored Shear Resistance Vr (kN) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
500	116.4	178.7	211.0	311.0	374.0	460.2

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties, Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3			Factored Moment Resistance M_r kN m	Factored Moment Resistance L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
610	127	x	6	1612.9	622	152.99	491.7	2.17	34.1			154.9	1890	23.3	27.5	29.7	36.0	40.3	46.6
	152	x	6**	1736.1	622	164.67	529.2	2.70	39.6			166.7	2040	25.8	30.1	32.2	38.6	42.8	49.2
	152	x	8	2419.4	625	230.67	737.6	4.68	61.5			232.3	2280	29.6	33.9	36.0	42.4	46.6	53.0
	152	x	10	2903.2	629	278.23	885.2	5.62	73.7			278.8	2290	33.4	37.7	39.8	46.1	50.4	56.8
	178	x		3387.1	629	324.61	1032.7	8.92	100.4			325.3	2670	37.2	41.5	43.6	49.9	54.2	60.6
	152	x	13	3871	635	374.82	1180.5	7.49	98.3			371.9	2310	41.0	45.2	47.4	53.7	58.0	64.4
	178	x		4516.1	635	437.29	1377.3	11.90	133.8			433.8	2690	46.1	50.3	52.4	58.8	63.1	69.4
	203	x		5161.3	635	499.76	1574.0	17.76	174.8			495.8	3080	51.1	55.4	57.5	63.9	68.1	74.5
	152	x	19	5806.4	648	573.85	1772.0	11.24	147.5			558.2	2360	56.2	60.4	62.6	68.9	73.2	79.6
	203	x	16	6451.6	641	631.13	1968.1	22.20	218.5			620.0	3110	61.3	65.5	67.6	74.0	78.3	84.6
	203	x	19	7741.9	648	765.14	2362.6	26.64	262.2			744.2	3150	71.4	75.6	77.8	84.1	88.4	94.7
	254	x		9677.4	648	956.42	2953.3	52.03	409.7			930.3	3930	86.6	90.8	93.0	99.3	103.6	109.9
	203	x	25	10323	660	1041.13	3153.0	35.52	349.6			993.2	3240	91.6	95.9	98.0	104.4	108.6	115.0
	254	x		12903	660	1301.42	3941.3	69.37	546.2			1241.5	4050	111.9	116.2	118.3	124.6	128.9	135.3
	279	x		14194	660	1431.56	4335.4	92.33	660.9			1365.7	4460	122.0	126.3	128.4	134.8	139.0	145.4
	305	x		15484	660	1561.70	4729.6	119.87	786.6			1489.8	4860	132.2	136.4	138.5	144.9	149.2	155.5
	254	x	32	16129	673	1659.94	4932.2	86.71	682.8			1553.7	4190	137.2	141.5	143.6	150.0	154.2	160.6
	330	x	25	16774	660	1691.84	5123.7	152.41	923.1			1614.0	5270	142.3	146.5	148.7	155.0	159.3	165.7
	356	x		18064	660	1821.98	5517.8	190.36	1070.6			1738.1	5670	152.4	156.7	158.8	165.2	169.4	175.8
	305	x	32	19355	673	1991.93	5918.7	149.84	983.2			1864.4	5030	162.5	166.8	168.9	175.3	179.5	185.9
	406	x	25	20645	660	2082.27	6306.1	284.15	1398.4			1986.4	6480	172.7	176.9	179.1	185.4	189.7	196.0
	356	x	32	22581	673	2323.92	6905.1	237.95	1338.3			2175.1	5870	187.9	192.1	194.3	200.6	204.9	211.2
	406	x		25806	673	2655.90	7891.6	355.18	1748.0			2485.8	6710	213.2	217.4	219.6	225.9	230.2	236.6
	450	x		28575	673	2940.84	8738.2	482.20	2143.1			2752.5	7440	234.9	239.2	241.3	247.7	251.9	258.3

Factored Shear Resistance Vr (kN): Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
610	139.9	215.8	255.0	377.0	456.0	561.1

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3			Factored Moment Resistance M_r kN m	L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
750	127	x	6	1612.9	763	230.68	604.9	2.17	34.1			190.5	1890	25.7	30.9	33.6	41.4	46.6	54.5
	152	x	6 **	1736.1	763	248.30	651.1	2.70	39.6			205.1	2030	28.3	33.5	36.1	43.9	49.2	57.0
	152	x	8	2419.4	766	347.47	907.4	4.68	61.5			285.8	2270	32.1	37.3	39.9	47.7	53.0	60.8
	152	x	10	2903.2	769	418.72	1088.9	5.62	73.7			343.0	2280	35.8	41.1	43.7	51.5	56.8	64.6
	178	x		3387.1	769	488.51	1270.4	8.92	100.4			400.2	2660	39.6	44.9	47.5	55.3	60.6	68.4
	152	x	13	3871	775	563.00	1452.1	7.49	98.3			457.4	2290	43.4	48.7	51.3	59.1	64.4	72.2
	178	x		4516.1	775	656.83	1694.2	11.90	133.8			533.7	2670	48.5	53.7	56.4	64.2	69.4	77.2
	203	x		5161.3	775	750.66	1936.2	17.76	174.8			609.9	3060	53.6	58.8	61.4	69.3	74.5	82.3
	152	x	19	5806.4	788	858.71	2179.2	11.24	147.5			686.4	2330	58.6	63.9	66.5	74.3	79.5	87.4
	203	x	16	6451.6	782	946.21	2420.7	22.20	218.5			762.5	3080	63.7	68.9	71.6	79.4	84.6	92.4
	203	x	19	7741.9	788	1144.95	2905.6	26.64	262.2			915.3	3100	73.8	79.1	81.7	89.5	94.7	102.6
	254	x		9677.4	788	1431.19	3632.0	52.03	409.7			1144.1	3880	89.0	94.3	96.9	104.7	109.9	117.8
	203	x	25	10323	801	1552.15	3876.5	35.52	349.6			1221.1	3170	94.1	99.3	101.9	109.8	115.0	122.8
	254	x		12903	801	1940.19	4845.6	69.37	546.2			1526.4	3960	114.3	119.6	122.2	130.0	135.3	143.1
	279	x		14194	801	2134.21	5330.2	92.33	660.9			1679.0	4360	124.5	129.7	132.3	140.2	145.4	153.2
	305	x		15484	801	2328.23	5814.8	119.87	786.6			1831.6	4750	134.6	139.8	142.5	150.3	155.5	163.3
	254	x	32	16129	814	2465.60	6061.7	86.71	682.8			1909.4	4060	139.7	144.9	147.5	155.4	160.6	168.4
	330	x	25	16774	801	2522.25	6299.3	152.41	923.1			1984.3	5150	144.7	150.0	152.6	160.4	165.6	173.5
	356	x		18064	801	2716.27	6783.9	190.36	1070.6			2136.9	5550	154.9	160.1	162.7	170.5	175.8	183.6
	305	x	32	19355	814	2958.72	7274.0	149.84	983.2			2291.3	4870	165.0	170.2	172.8	180.7	185.9	193.7
	406	x	25	20645	801	3104.30	7753.0	284.15	1398.4			2442.2	6340	175.1	180.3	183.0	190.8	196.0	203.9
	356	x	32	22581	814	3451.83	8486.4	237.95	1338.3			2673.2	5680	190.3	195.5	198.2	206.0	211.2	219.1
	406	x		25806	814	3944.95	9698.7	355.18	1748.0			3055.1	6500	215.6	220.9	223.5	231.3	236.5	244.4
	450	x		28575	814	4368.18	10739.2	482.20	2143.1			3382.9	7190	237.4	242.6	245.2	253.1	258.3	266.1

Factored Shear Resistance Vr (kN)

Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
750	169.9	263.2	311.3	461.5	561.0	690.3

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3			Factored Moment Resistance M_r kN m	Factored Moment Resistance L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
900	127	x	6	1612.9	913	331.24	725.9	2.17	34.1			228.6	1880	28.3	34.6	37.8	47.1	53.4	62.8
	152	x	6 **	1736.1	913	356.54	781.3	2.70	39.6			246.1	2030	30.9	37.1	40.3	49.7	56.0	65.4
	152	x	8	2419.4	916	498.61	1088.8	4.68	61.5			343.0	2270	34.7	40.9	44.1	53.5	59.8	69.1
	152	x	10	2903.2	919	600.43	1306.6	5.62	73.7			411.6	2270	38.5	44.7	47.9	57.3	63.6	72.9
	178	x		3387.1	919	700.51	1524.4	8.92	100.4			480.2	2650	42.3	48.5	51.7	61.1	67.3	76.7
	152	x	13	3871	925	806.20	1742.4	7.49	98.3			548.9	2280	46.1	52.3	55.5	64.9	71.1	80.5
	178	x		4516.1	925	940.57	2032.8	11.90	133.8			640.3	2660	51.1	57.4	60.5	69.9	76.2	85.6
	203	x		5161.3	925	1074.93	2323.2	17.76	174.8			731.8	3040	56.2	62.5	65.6	75.0	81.3	90.7
	152	x	19	5806.4	938	1226.28	2614.4	11.24	147.5			823.5	2310	61.3	67.5	70.7	80.1	86.3	95.7
	203	x	16	6451.6	932	1353.08	2904.4	22.20	218.5			914.9	3060	66.3	72.6	75.7	85.1	91.4	100.8
	203	x	19	7741.9	938	1635.04	3485.9	26.64	262.2			1098.0	3080	76.4	82.7	85.9	95.3	101.5	110.9
	254	x		9677.4	938	2043.80	4357.3	52.03	409.7			1372.6	3850	91.6	97.9	101.1	110.5	116.7	126.1
	203	x	25	10323	951	2210.53	4649.8	35.52	349.6			1464.7	3120	96.7	103.0	106.1	115.5	121.8	131.2
	254	x		12903	951	2763.16	5812.3	69.37	546.2			1830.9	3910	117.0	123.2	126.4	135.8	142.1	151.4
	279	x		14194	951	3039.47	6393.5	92.33	660.9			2014.0	4300	127.1	133.4	136.5	145.9	152.2	161.6
	305	x		15484	951	3315.79	6974.7	119.87	786.6			2197.0	4690	137.2	143.5	146.6	156.0	162.3	171.7
	254	x	32	16129	964	3501.99	7269.3	86.71	682.8			2289.8	3980	142.3	148.6	151.7	161.1	167.4	176.8
	330	x	25	16774	951	3592.10	7556.0	152.41	923.1			2380.1	5080	147.3	153.6	156.8	166.2	172.4	181.8
	356	x		18064	951	3868.42	8137.2	190.36	1070.6			2563.2	5470	157.5	163.7	166.9	176.3	182.6	192.0
	305	x	32	19355	964	4202.38	8723.2	149.84	983.2			2747.8	4770	167.6	173.9	177.0	186.4	192.7	202.1
	406	x	25	20645	951	4421.05	9299.6	284.15	1398.4			2929.4	6250	177.7	184.0	187.2	196.6	202.8	212.2
	356	x	32	22581	964	4902.78	10177.0	237.95	1338.3			3205.8	5570	192.9	199.2	202.3	211.7	218.0	227.4
	406	x		25806	964	5603.18	11630.9	355.18	1748.0			3663.7	6360	218.3	224.5	227.7	237.1	243.3	252.7
	450	x		28575	964	6204.30	12878.7	482.20	2143.1			4056.8	7050	240.0	246.3	249.4	258.8	265.1	274.5

Factored Shear Resistance Vr (kN)

Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
900	201.7	313.7	371.3	551.7	673.2	828.4

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm2)	Overall Depth d (mm)	Section Properties Strong Axis I_x 10^6 mm^4	Strong Axis S_x 10^3 mm^3	Weak Axis I_y 10^6 mm^4	Weak Axis S_y 10^3 mm^3			Factored Moment Resistance M_r kN m	L_u mm	Beam Weight WTA kg / m	WTB kg / m	WTC kg / m	WTF kg / m	WTH kg / m	WTK kg / m
a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
1000	127	x	6	1612.9	1013	408.37	806.5	2.17	34.1			254.0	1880	30.1	37.0	40.5	51.0	58.0	68.4
	152	x	6 **	1736.1	1013	439.56	868.1	2.70	39.6			273.4	2030	32.6	39.6	43.1	53.5	60.5	70.9
	152	x	8	2419.4	1016	614.49	1209.8	4.68	61.5			381.1	2260	36.4	43.4	46.9	57.3	64.3	74.7
	152	x	10	2903.2	1019	739.72	1451.8	5.62	73.7			457.3	2270	40.2	47.2	50.7	61.1	68.1	78.5
	178	x		3387.1	1019	863.01	1693.7	8.92	100.4			533.5	2650	44.0	51.0	54.5	64.9	71.9	82.3
	152	x	13	3871	1025	992.53	1935.9	7.49	98.3			609.8	2280	47.8	54.8	58.3	68.7	75.7	86.1
	178	x		4516.1	1025	1157.95	2258.5	11.90	133.8			711.4	2660	52.9	59.8	63.3	73.8	80.7	91.2
	203	x		5161.3	1025	1323.37	2581.2	17.76	174.8			813.1	3040	57.9	64.9	68.4	78.8	85.8	96.2
	152	x	19	5806.4	1038	1507.62	2904.6	11.24	147.5			914.9	2300	63.0	70.0	73.5	83.9	90.9	101.3
	203	x	16	6451.6	1032	1664.65	3226.9	22.20	218.5			1016.5	3050	68.1	75.0	78.5	89.0	95.9	106.4
	203	x	19	7741.9	1038	2010.16	3872.8	26.64	262.2			1219.9	3070	78.2	85.2	88.7	99.1	106.1	116.5
	254	x		9677.4	1038	2512.70	4841.0	52.03	409.7			1524.9	3830	93.4	100.3	103.8	114.3	121.3	131.7
	203	x	25	10323	1051	2713.96	5165.5	35.52	349.6			1627.1	3100	98.4	105.4	108.9	119.4	126.3	136.8
	254	x		12903	1051	3392.45	6456.9	69.37	546.2			2033.9	3880	118.7	125.7	129.2	139.6	146.6	157.0
	279	x		14194	1051	3731.69	7102.6	92.33	660.9			2237.3	4270	128.8	135.8	139.3	149.7	156.7	167.2
	305	x		15484	1051	4070.93	7748.3	119.87	786.6			2440.7	4660	139.0	145.9	149.4	159.9	166.8	177.3
	254	x	32	16129	1064	4293.72	8074.7	86.71	682.8			2543.5	3940	144.0	151.0	154.5	164.9	171.9	182.3
	330	x	25	16774	1051	4410.18	8393.9	152.41	923.1			2644.1	5050	149.1	156.1	159.6	170.0	177.0	187.4
	356	x		18064	1051	4749.42	9039.6	190.36	1070.6			2847.5	5440	159.2	166.2	169.7	180.1	187.1	197.5
	305	x	32	19355	1064	5152.46	9689.6	149.84	983.2			3052.2	4730	169.3	176.3	179.8	190.3	197.2	207.7
	406	x	25	20645	1051	5427.91	10331.0	284.15	1398.4			3254.3	6210	179.5	186.4	189.9	200.4	207.4	217.8
	356	x	32	22581	1064	6011.20	11304.6	237.95	1338.3			3560.9	5520	194.7	201.6	205.1	215.6	222.5	233.0
	406	x		25806	1064	6869.95	12919.5	355.18	1748.0			4069.6	6310	220.0	227.0	230.5	240.9	247.9	258.3
	450	x		28575	1064	7606.98	14305.6	482.20	2143.1			4506.3	6980	241.7	248.7	252.2	262.6	269.6	280.0

Factored Shear Resistance Vr (kN) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
1000	222.9	347.3	411.2	611.8	748.0	920.4

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web	Flange				Overall Depth	Section Properties						Factored Moment Resistance		Beam Weight					
	Width		Thickness	Area		Strong Axis		Weak Axis											
h_w	b_f		t_f		d	I_x	S_x	I_y	S_y			M_r	L_u	WTA	WTB	WTC	WTF	WTH	WTK
(mm)	(mm)		(mm)	(mm2)	(mm)	10^6 mm^4	10^3 mm^3	10^6 mm^4	10^3 mm^3			kN m	mm	kg / m	kg / m	kg / m	kg / m	kg / m	kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
1219	127	x	6	1612.9	1232	605.64	983.3	2.17	34.1			309.7	1880	33.9	42.4	46.6	59.4	67.9	80.6
	152	x	6 **	1736.1	1232	651.90	1058.4	2.70	39.6			333.4	2020	36.4	44.9	49.2	61.9	70.4	83.1
	152	x	8	2419.4	1235	910.82	1474.9	4.68	61.5			464.6	2260	40.2	48.7	53.0	65.7	74.2	86.9
	152	x	10	2903.2	1238	1095.82	1769.9	5.62	73.7			557.5	2260	44.0	52.5	56.8	69.5	78.0	90.7
	178	x		3387.1	1238	1278.45	2064.9	8.92	100.4			650.5	2640	47.8	56.3	60.6	73.3	81.8	94.5
	152	x	13	3871	1245	1468.67	2360.1	7.49	98.3			743.4	2270	51.6	60.1	64.4	77.1	85.6	98.3
	178	x		4516.1	1245	1713.45	2753.4	11.90	133.8			867.3	2650	56.7	65.2	69.4	82.2	90.7	103.4
	203	x		5161.3	1245	1958.23	3146.8	17.76	174.8			991.2	3030	61.7	70.2	74.5	87.2	95.7	108.5
	152	x	19	5806.4	1257	2225.88	3540.7	11.24	147.5			1115.3	2290	66.8	75.3	79.6	92.3	100.8	113.5
	203	x	16	6451.6	1251	2460.47	3933.8	22.20	218.5			1239.1	3040	71.9	80.4	84.6	97.4	105.9	118.6
	203	x	19	7741.9	1257	2967.83	4721.0	26.64	262.2			1487.1	3050	82.0	90.5	94.8	107.5	116.0	128.7
	254	x		9677.4	1257	3709.79	5901.2	52.03	409.7			1858.9	3810	97.2	105.7	110.0	122.7	131.2	143.9
	203	x	25	10323	1270	3998.04	6296.1	35.52	349.6			1983.3	3080	102.3	110.8	115.0	127.8	136.2	149.0
	254	x		12903	1270	4997.55	7870.2	69.37	546.2			2479.1	3850	122.5	131.0	135.3	148.0	156.5	169.2
	279	x		14194	1270	5497.31	8657.2	92.33	660.9			2727.0	4230	132.6	141.1	145.4	158.1	166.6	179.4
	305	x		15484	1270	5997.06	9444.2	119.87	786.6			2974.9	4620	142.8	151.3	155.5	168.3	176.8	189.5
	254	x	32	16129	1283	6311.33	9840.7	86.71	682.8			3099.8	3890	147.8	156.3	160.6	173.3	181.8	194.6
	330	x	25	16774	1270	6496.82	10231.2	152.41	923.1			3222.8	5000	152.9	161.4	165.7	178.4	186.9	199.6
	356	x		18064	1270	6996.57	11018.2	190.36	1070.6			3470.7	5390	163.0	171.5	175.8	188.5	197.0	209.8
	305	x	32	19355	1283	7573.59	11808.8	149.84	983.2			3719.8	4670	173.2	181.7	185.9	198.7	207.2	219.9
	406	x	25	20645	1270	7996.08	12592.3	284.15	1398.4			3966.6	6160	183.3	191.8	196.1	208.8	217.3	230.0
	356	x	32	22581	1283	8835.86	13777.0	237.95	1338.3			4339.7	5440	198.5	207.0	211.2	224.0	232.5	245.2
	406	x		25806	1283	10098.12	15745.1	355.18	1748.0			4959.7	6220	223.8	232.3	236.6	249.3	257.8	270.5
	450	x		28575	1283	11181.48	17434.3	482.20	2143.1			5491.8	6890	245.5	254.0	258.3	271.0	279.5	292.3

Factored Shear Resistance Vr (kN)						
Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
1219	269.1	420.9	498.7	743.4	911.2	1122.2

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Metric

Depth of Web	Flange				Overall	Section Properties						Factored Moment Resistance		Beam Weight					
	Width		Thickness	Area	Depth	Strong Axis		Weak Axis											
h_w	b_f		t_f		d	I_x	S_x	I_y	S_y			M_r	L_u	WTA	WTB	WTC	WTF	WTH	WTK
(mm)	(mm)		(mm)	(mm2)	(mm)	10^6 mm^4	10^3 mm^3	10^6 mm^4	10^3 mm^3			kN m	mm	kg / m	kg / m	kg / m	kg / m	kg / m	kg / m
a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
1500	127	x	6	1612.9	1513	914.96	1209.7	2.17	34.1			381.1	1880	38.8	49.2	54.5	70.1	80.6	96.3
	152	x	6 **	1736.1	1513	984.84	1302.1	2.70	39.6			410.2	2020	41.3	51.8	57.0	72.7	83.1	98.8
	152	x	8	2419.4	1516	1375.34	1814.6	4.68	61.5			571.6	2260	45.1	55.6	60.8	76.5	86.9	102.6
	152	x	10	2903.2	1519	1653.89	2177.5	5.62	73.7			685.9	2260	48.9	59.4	64.6	80.3	90.7	106.4
	178	x		3387.1	1519	1929.54	2540.5	8.92	100.4			800.2	2640	52.7	63.2	68.4	84.1	94.5	110.2
	152	x	13	3871	1525	2214.49	2903.5	7.49	98.3			914.6	2260	56.5	67.0	72.2	87.9	98.3	114.0
	178	x		4516.1	1525	2583.58	3387.4	11.90	133.8			1067.0	2640	61.6	72.0	77.3	92.9	103.4	119.0
	203	x		5161.3	1525	2952.66	3871.3	17.76	174.8			1219.5	3020	66.6	77.1	82.3	98.0	108.4	124.1
	152	x	19	5806.4	1538	3349.78	4355.7	11.24	147.5			1372.1	2280	71.7	82.2	87.4	103.1	113.5	129.2
	203	x	16	6451.6	1532	3706.38	4839.4	22.20	218.5			1524.4	3030	76.8	87.2	92.5	108.1	118.6	134.2
	203	x	19	7741.9	1538	4466.38	5807.7	26.64	262.2			1829.4	3040	86.9	97.3	102.6	118.3	128.7	144.4
	254	x		9677.4	1538	5582.97	7259.6	52.03	409.7			2286.8	3800	102.1	112.5	117.8	133.4	143.9	159.6
	203	x	25	10323	1551	6005.30	7744.8	35.52	349.6			2439.6	3060	107.1	117.6	122.8	138.5	149.0	164.6
	254	x		12903	1551	7506.63	9681.0	69.37	546.2			3049.5	3820	127.4	137.9	143.1	158.8	169.2	184.9
	279	x		14194	1551	8257.29	10649.1	92.33	660.9			3354.5	4200	137.5	148.0	153.2	168.9	179.4	195.0
	305	x		15484	1551	9007.96	11617.2	119.87	786.6			3659.4	4590	147.7	158.1	163.4	179.0	189.5	205.1
	254	x	32	16129	1564	9462.05	12103.7	86.71	682.8			3812.7	3850	152.7	163.2	168.4	184.1	194.5	210.2
	330	x	25	16774	1551	9758.62	12585.3	152.41	923.1			3964.4	4970	157.8	168.2	173.5	189.2	199.6	215.3
	356	x		18064	1551	10509.28	13553.4	190.36	1070.6			4269.3	5350	167.9	178.4	183.6	199.3	209.7	225.4
	305	x	32	19355	1564	11354.46	14524.4	149.84	983.2			4575.2	4620	178.1	188.5	193.8	209.4	219.9	235.5
	406	x	25	20645	1551	12010.61	15489.6	284.15	1398.4			4879.2	6120	188.2	198.6	203.9	219.5	230.0	245.7
	356	x	32	22581	1564	13246.88	16945.2	237.95	1338.3			5337.7	5390	203.4	213.8	219.1	234.7	245.2	260.9
	406	x		25806	1564	15139.29	19365.9	355.18	1748.0			6100.3	6160	228.7	239.2	244.4	260.1	270.5	286.2
	450	x		28575	1564	16763.48	21443.5	482.20	2143.1			6754.7	6820	250.4	260.9	266.1	281.8	292.2	307.9

Factored Shear Resistance Vr (kN)						
Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
1500	281.2	448.5	581.8	895.7	1118.6	1380.6

SIN Beam Bending Properties

Metric

Depth	Flange				Overall	Section Properties						Factored Moment		Beam Weight					
of Web	Width		Thickness	Area	Depth	Strong Axis		Weak Axis				Resistance							
h_w	b_f		t_f		d	I_x	S_x	I_y	S_y			M_r	L_u	WTA	WTB	WTC	WTF	WTH	WTK
(mm)	(mm)		(mm)	(mm2)	(mm)	10^6 mm^4	10^3 mm^3	10^6 mm^4	10^3 mm^3			kN m	mm	kg / m	kg / m	kg / m	kg / m	kg / m	kg / m
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*

Notes

- SIN Beam sizes are indicated as WT[WEB THICKNESS] [WEB DEPTH] / [FLANGE WIDTH] x [FLANGE THICKNESS] - [WEIGHT]
  i.e. For a 914mm x 2.5mm web with 254mm x 16mm Flanges and a Weight of 86.5 kg/m the designation is WTB915 / 254x16 - 86.5
- Flanges and Webs are all fabricated from W350 Material (Fy = 350MPa)
- Flanges of over 16mm in thickness will include a premium due to the required splicing of the flat bar

** 152x6 Section Properties, Axial and Moment resistance based on a flange width of 136mm to be Class 3

a Depth of the Beam web, i.e. Inside of flanges
b Width of top and bottom flange
d Thickess of top and bottom flange
e Cross sectionional area of flanges only (web is neglected)
f Overall depth of section
g Strong Axis Moment of Inertia computed using flange properties only
h Strong Axis Section Modulas computed using flange properties only
i Weak Axis Moment of Inertia computed using flange properties only
j Weak Axis Section Modulas computed using flange properties only
m Strong Axis Factored Moment Restance assuming compression flange is fully braced based on CSA S16
n Maximum unbraced lenght for which Mr is applicable
o - u Mass of member per unit length with a web thickess of 16ga (1.519mm); 14ga (1.897mm); 12ga; 11ga; 8ga; 6ga; 3ga

aa Depth of Beam web
bb - hh Shear Capacity for a 16 ga (1.519mm); 14ga; 12ga; 11ga; 8ga; 6ga; 3ga web

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w in	Flange Width b_f in		Flange Thickness t_f in	Area in^2	Overall Depth d in	Section Properties Strong Axis I_x in^4	Strong Axis S_x in^3	Weak Axis I_y in^4	Weak Axis S_y in^3	Factored Moment Resistance M_r kip ft	L_u in	Beam Weight WTA lb / ft	WTB lb / ft	WTC lb / ft	WTF lb / ft	WTH lb / ft	WTK lb / ft
-	a	b	c	d	e	f	g	h	i	j	m	n	p	q	r	s	t	u
WT_333/127x6	13.1	5.0	x	0.250	2.50	13.61	129	16.4	6.0	2.1	62.4	75	12.4	13.9	14.7	17.0	18.6	20.9
WT_333/152x6		6 x 0.250**			2.69	13.61	139	17.6	7.5	2.4	67.2	81	14.1	15.6	16.4	18.7	20.3	22.6
WT_333/152x8		6.0	x	0.313	3.75	13.74	195	24.6	13.0	3.8	93.7	91	16.6	18.2	19.0	21.3	22.8	25.2
WT_333/152x10		6.0	x	0.375	4.50	13.86	236	29.5	15.6	4.5	112.4	92	19.2	20.7	21.5	23.8	25.4	27.7
WT_333/178x10		7.0	x		5.25	13.86	276	34.4	24.8	6.1	131.2	107	21.7	23.3	24.1	26.4	27.9	30.3
WT_333/152x13		6.0	x	0.500	6.00	14.11	321	39.4	20.8	6.0	150.0	94	24.3	25.8	26.6	28.9	30.5	32.8
WT_333/178x13		7.0	x		7.00	14.11	375	46.0	33.0	8.2	175.0	110	27.7	29.2	30.0	32.3	33.9	36.2
WT_333/203x13		8.0	x		8.00	14.11	428	52.5	49.3	10.7	200.0	126	31.1	32.6	33.4	35.7	37.3	39.6
WT_333/152x19		6.0	x	0.750	9.00	14.61	500	59.2	31.2	9.0	225.5	101	34.5	36.0	36.8	39.1	40.7	43.0
WT_333/203x16		8.0	x	0.625	10.00	14.36	545	65.7	61.6	13.3	250.3	130	37.8	39.4	40.2	42.5	44.1	46.4
WT_333/203x19		8.0	x	0.750	12.00	14.61	666	79.0	73.9	16.0	300.7	134	44.6	46.2	47.0	49.3	50.9	53.2
WT_333/254x19		10.0	x		15.00	14.61	833	98.7	144.4	25.0	375.8	168	54.8	56.4	57.2	59.5	61.1	63.4
WT_333/203x25		8.0	x	1.000	16.00	15.11	922	105.6	98.6	21.3	402.0	146	58.2	59.8	60.6	62.9	64.4	66.8
WT_333/254x25		10.0	x		20.00	15.11	1152	132.0	192.5	33.3	502.5	183	71.8	73.4	74.1	76.5	78.0	80.4
WT_333/279x25		11.0	x		22.00	15.11	1267	145.2	256.3	40.3	552.7	201	78.6	80.2	80.9	83.3	84.8	87.2
WT_333/305x25		12.0	x		24.00	15.11	1382	158.4	332.7	48.0	603.0	219	85.4	86.9	87.7	90.1	91.6	93.9
WT_333/254x32		10.0	x	1.250	25.00	15.61	1493	165.5	240.7	41.7	630.3	201	88.8	90.3	91.1	93.5	95.0	97.3
WT_333/330x25		13.0	x	1.000	26.00	15.11	1498	171.6	423.0	56.3	653.2	238	92.2	93.7	94.5	96.9	98.4	100.7
WT_333/356x25		14.0	x		28.00	15.11	1613	184.8	528.3	65.3	703.5	256	99.0	100.5	101.3	103.6	105.2	107.5
WT_333/305x32		12.0	x	1.250	30.00	15.61	1791	198.7	415.9	60.0	756.3	241	105.8	107.3	108.1	110.4	112.0	114.3
WT_333/406x25		16.0	x	1.000	32.00	15.11	1843	211.2	788.6	85.3	804.0	292	112.6	114.1	114.9	117.2	118.8	121.1
WT_333/356x32		14.0	x	1.250	35.00	15.61	2090	231.8	660.4	81.7	882.4	281	122.7	124.3	125.1	127.4	129.0	131.3
WT_333/406x32		16.0	x		40.00	15.61	2388	264.9	985.8	106.7	1008.4	322	139.7	141.3	142.1	144.4	146.0	148.3
WT_333/450x32		17.7	x		44.29	15.61	2645	293.3	1338.3	130.8	1116.6	356	154.3	155.9	156.6	159.0	160.5	162.9

Factored Shear Resistance Vr (kip) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
13	18.0	27.4	32.3	47.2	56.0	68.9

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Flange Area (in^2)	Overall Depth d (in)	Strong Axis I_x (in^4)	Strong Axis S_x (in^3)	Weak Axis I_y (in^4)	Weak Axis S_y (in^3)	Factored Moment Resistance M_r (kip ft)	L_u (in)	WTA (lb / ft)	WTB (lb / ft)	WTC (lb / ft)	WTF (lb / ft)	WTH (lb / ft)	WTK (lb / ft)
-	a	b	c	d	e	f	g	h	i	j	m	n	p	q	r	s	t	u
WT_ 440/127x6	17.3	5.0	x	0.250	2.50	17.82	223	21.7	6.0	2.1	82.5	75	13.6	15.7	16.7	19.8	21.9	24.9
WT_ 440/152x6		6 x 0.250 **			2.69	17.82	240	23.3	7.5	2.4	88.8	80	15.3	17.4	18.4	21.5	23.6	26.6
WT_ 440/152x8		6.0	x	0.313	3.75	17.95	337	32.5	13.0	3.8	123.7	90	17.9	19.9	21.0	24.0	26.1	29.2
WT_ 440/152x10		6.0	x	0.375	4.50	18.07	407	39.0	15.6	4.5	148.5	91	20.4	22.5	23.5	26.6	28.6	31.7
WT_ 440/178x10		7.0	x		5.25	18.07	475	45.5	24.8	6.1	173.2	106	23.0	25.0	26.1	29.1	31.2	34.3
WT_ 440/152x13		6.0	x	0.500	6.00	18.32	551	52.0	20.8	6.0	198.1	92	25.5	27.6	28.6	31.7	33.7	36.8
WT_ 440/178x13		7.0	x		7.00	18.32	642	60.7	33.0	8.2	231.1	107	28.9	31.0	32.0	35.1	37.1	40.2
WT_ 440/203x13		8.0	x		8.00	18.32	734	69.4	49.3	10.7	264.1	123	32.3	34.4	35.4	38.5	40.5	43.6
WT_ 440/152x19		6.0	x	0.750	9.00	18.82	849	78.1	31.2	9.0	297.5	96	35.7	37.8	38.8	41.9	43.9	47.0
WT_ 440/203x16		8.0	x	0.625	10.00	18.57	931	86.8	61.6	13.3	330.3	125	39.1	41.2	42.2	45.3	47.3	50.4
WT_ 440/203x19		8.0	x	0.750	12.00	18.82	1133	104.2	73.9	16.0	396.6	128	45.9	47.9	49.0	52.1	54.1	57.2
WT_ 440/254x19		10.0	x		15.00	18.82	1416	130.2	144.4	25.0	495.8	160	56.1	58.1	59.2	62.2	64.3	67.4
WT_ 440/203x25		8.0	x	1.000	16.00	19.32	1553	139.1	98.6	21.3	529.7	135	59.5	61.5	62.6	65.6	67.7	70.8
WT_ 440/254x25		10.0	x		20.00	19.32	1941	173.9	192.5	33.3	662.1	168	73.1	75.1	76.1	79.2	81.3	84.4
WT_ 440/279x25		11.0	x		22.00	19.32	2135	191.3	256.3	40.3	728.4	185	79.9	81.9	82.9	86.0	88.1	91.2
WT_ 440/305x25		12.0	x		24.00	19.32	2329	208.7	332.7	48.0	794.6	202	86.6	88.7	89.7	92.8	94.9	97.9
WT_ 440/254x32		10.0	x	1.250	25.00	19.82	2494	217.8	240.7	41.7	829.4	179	90.0	92.1	93.1	96.2	98.3	101.3
WT_ 440/330x25		13.0	x	1.000	26.00	19.32	2523	226.1	423.0	56.3	860.8	219	93.4	95.5	96.5	99.6	101.7	104.7
WT_ 440/356x25		14.0	x		28.00	19.32	2718	243.5	528.3	65.3	927.0	236	100.2	102.3	103.3	106.4	108.5	111.5
WT_ 440/305x32		12.0	x	1.250	30.00	19.82	2993	261.4	415.9	60.0	995.3	215	107.0	109.1	110.1	113.2	115.2	118.3
WT_ 440/406x25		16.0	x	1.000	32.00	19.32	3106	278.3	788.6	85.3	1059.4	270	113.8	115.9	116.9	120.0	122.0	125.1
WT_ 440/356x32		14.0	x	1.250	35.00	19.82	3492	305.0	660.4	81.7	1161.2	251	124.0	126.1	127.1	130.2	132.2	135.3
WT_ 440/406x32		16.0	x		40.00	19.82	3991	348.6	985.8	106.7	1327.0	287	141.0	143.0	144.1	147.1	149.2	152.3
WT_ 440/450x32		17.7	x		44.29	19.82	4419	386.0	1338.3	130.8	1469.4	318	155.6	157.6	158.6	161.7	163.8	166.9

Factored Shear Resistance Vr (kip)						
Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
17	23.3	35.6	42.0	61.8	74.0	91.0

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web	Flange				Overall Depth	Section Properties				Factored Moment Resistance		Beam Weight					
		Width		Thickness	Area		Strong Axis		Weak Axis									
	h_w	b_f		t_f		d	I_x	S_x	I_y	S_y	M_r	L_u	WTA	WTB	WTC	WTF	WTH	WTK
	in	in		in	in^2	in	in^4	in^3	in^4	in^3	kip ft	in	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft
-	a	b	c	d	e	f	g	h	i	j	m	n	p	q	r	s	t	u
WT_500/127x6	19.7	5.0	x	0.250	2.50	20.19	287	24.6	6.0	2.1	93.7	74	14.3	16.7	17.8	21.3	23.7	27.2
WT_500/152x6		6 x 0.250 **			2.69	20.19	309	26.5	7.5	2.4	100.9	80	16.0	18.4	19.5	23.0	25.4	28.9
WT_500/152x8		6.0	x	0.313	3.75	20.31	433	36.9	13.0	3.8	140.6	90	18.6	20.9	22.1	25.6	27.9	31.4
WT_500/152x10		6.0	x	0.375	4.50	20.44	523	44.3	15.6	4.5	168.7	90	21.1	23.5	24.6	28.1	30.5	34.0
WT_500/178x10		7.0	x		5.25	20.44	610	51.7	24.8	6.1	196.8	105	23.7	26.0	27.2	30.7	33.0	36.5
WT_500/152x13		6.0	x	0.500	6.00	20.69	706	59.1	20.8	6.0	225.0	91	26.2	28.6	29.7	33.2	35.6	39.1
WT_500/178x13		7.0	x		7.00	20.69	824	69.0	33.0	8.2	262.5	107	29.6	31.9	33.1	36.6	39.0	42.5
WT_500/203x13		8.0	x		8.00	20.69	942	78.8	49.3	10.7	300.0	122	33.0	35.3	36.5	40.0	42.4	45.9
WT_500/152x19		6.0	x	0.750	9.00	21.19	1086	88.7	31.2	9.0	337.9	94	36.4	38.7	39.9	43.4	45.7	49.3
WT_500/203x16		8.0	x	0.625	10.00	20.94	1192	98.5	61.6	13.3	375.2	124	39.8	42.1	43.3	46.8	49.1	52.6
WT_500/203x19		8.0	x	0.750	12.00	21.19	1448	118.3	73.9	16.0	450.5	126	46.6	48.9	50.1	53.6	55.9	59.4
WT_500/254x19		10.0	x		15.00	21.19	1810	147.9	144.4	25.0	563.1	157	56.8	59.1	60.3	63.8	66.1	69.6
WT_500/203x25		8.0	x	1.000	16.00	21.69	1979	158.0	98.6	21.3	601.4	131	60.2	62.5	63.7	67.2	69.5	73.0
WT_500/254x25		10.0	x		20.00	21.69	2473	197.5	192.5	33.3	751.8	164	73.8	76.1	77.3	80.8	83.1	86.6
WT_500/279x25		11.0	x		22.00	21.69	2721	217.2	256.3	40.3	827.0	181	80.6	82.9	84.1	87.6	89.9	93.4
WT_500/305x25		12.0	x		24.00	21.69	2968	237.0	332.7	48.0	902.2	197	87.3	89.7	90.9	94.4	96.7	100.2
WT_500/254x32		10.0	x	1.250	25.00	22.19	3168	247.2	240.7	41.7	941.3	172	90.7	93.1	94.2	97.7	100.1	103.6
WT_500/330x25		13.0	x	1.000	26.00	21.69	3215	256.7	423.0	56.3	977.3	213	94.1	96.5	97.6	101.1	103.5	107.0
WT_500/356x25		14.0	x		28.00	21.69	3463	276.5	528.3	65.3	1052.5	230	100.9	103.3	104.4	107.9	110.3	113.8
WT_500/305x32		12.0	x	1.250	30.00	22.19	3802	296.7	415.9	60.0	1129.5	207	107.7	110.1	111.2	114.7	117.1	120.6
WT_500/406x25		16.0	x	1.000	32.00	21.69	3957	315.9	788.6	85.3	1202.9	263	114.5	116.8	118.0	121.5	123.9	127.4
WT_500/356x32		14.0	x	1.250	35.00	22.19	4435	346.1	660.4	81.7	1317.8	242	124.7	127.0	128.2	131.7	134.0	137.5
WT_500/406x32		16.0	x		40.00	22.19	5069	395.6	985.8	106.7	1506.1	276	141.7	144.0	145.2	148.7	151.0	154.5
WT_500/450x32		17.7	x		44.29	22.19	5613	438.0	1338.3	130.8	1667.6	306	156.3	158.6	159.8	163.3	165.6	169.1

Factored Shear Resistance Vr (kip)						
Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
20	26.2	40.2	47.4	69.9	84.1	103.5

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w in	Flange Width b_f in		Flange Thickness t_f in	Area in^2	Overall Depth d in	Section Properties: Strong Axis I_x in^4	Strong Axis S_x in^3	Weak Axis I_y in^4	Weak Axis S_y in^3			Factored Moment Resistance M_r kip ft	L_u in	Beam Weight WTA lb / ft	WTB lb / ft	WTC lb / ft	WTF lb / ft	WTH lb / ft	WTK lb / ft
-	a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
WT_ 610/127x6	24.0	5.0	x	0.250	2.50	24.50	425	30.0	6.0	2.1			114.2	74	15.6	18.5	19.9	24.2	27.0	31.3
WT_ 610/152x6		6 x 0.250**			2.69	24.50	457	32.3	7.5	2.4			123.0	80	17.3	20.2	21.6	25.9	28.7	33.0
WT_ 610/152x8		6.0	x	0.313	3.75	24.63	640	45.0	13.0	3.8			171.4	89	19.9	22.7	24.1	28.4	31.2	35.5
WT_ 610/152x10		6.0	x	0.375	4.50	24.75	772	54.0	15.6	4.5			205.7	90	22.4	25.2	26.7	30.9	33.8	38.1
WT_ 610/178x10		7.0	x		5.25	24.75	901	63.0	24.8	6.1			239.9	105	24.9	27.8	29.2	33.5	36.3	40.6
WT_ 610/152x13		6.0	x	0.500	6.00	25.00	1040	72.0	20.8	6.0			274.3	90	27.5	30.3	31.8	36.0	38.9	43.2
WT_ 610/178x13		7.0	x		7.00	25.00	1214	84.0	33.0	8.2			320.0	106	30.9	33.7	35.2	39.4	42.3	46.6
WT_ 610/203x13		8.0	x		8.00	25.00	1387	96.1	49.3	10.7			365.7	121	34.3	37.1	38.6	42.8	45.7	49.9
WT_ 610/152x19		6.0	x	0.750	9.00	25.50	1593	108.1	31.2	9.0			411.7	93	37.7	40.5	42.0	46.2	49.1	53.3
WT_ 610/203x16		8.0	x	0.625	10.00	25.25	1752	120.1	61.6	13.3			457.3	122	41.1	43.9	45.4	49.6	52.5	56.7
WT_ 610/203x19		8.0	x	0.750	12.00	25.50	2124	144.2	73.9	16.0			548.9	124	47.9	50.7	52.1	56.4	59.3	63.5
WT_ 610/254x19		10.0	x		15.00	25.50	2655	180.2	144.4	25.0			686.1	155	58.1	60.9	62.3	66.6	69.5	73.7
WT_ 610/203x25		8.0	x	1.000	16.00	26.00	2890	192.4	98.6	21.3			732.6	127	61.5	64.3	65.7	70.0	72.8	77.1
WT_ 610/254x25		10.0	x		20.00	26.00	3612	240.5	192.5	33.3			915.7	159	75.0	77.9	79.3	83.6	86.4	90.7
WT_ 610/279x25		11.0	x		22.00	26.00	3973	264.6	256.3	40.3			1007.3	175	81.8	84.7	86.1	90.4	93.2	97.5
WT_ 610/305x25		12.0	x		24.00	26.00	4334	288.6	332.7	48.0			1098.8	191	88.6	91.5	92.9	97.2	100.0	104.3
WT_ 610/254x32		10.0	x	1.250	25.00	26.50	4607	301.0	240.7	41.7			1145.9	165	92.0	94.9	96.3	100.6	103.4	107.7
WT_ 610/330x25		13.0	x	1.000	26.00	26.00	4696	312.7	423.0	56.3			1190.4	207	95.4	98.3	99.7	104.0	106.8	111.1
WT_ 610/356x25		14.0	x		28.00	26.00	5057	336.7	528.3	65.3			1282.0	223	102.2	105.1	106.5	110.8	113.6	117.9
WT_ 610/305x32		12.0	x	1.250	30.00	26.50	5529	361.2	415.9	60.0			1375.1	198	109.0	111.8	113.3	117.5	120.4	124.7
WT_ 610/406x25		16.0	x	1.000	32.00	26.00	5779	384.8	788.6	85.3			1465.1	255	115.8	118.6	120.1	124.3	127.2	131.5
WT_ 610/356x32		14.0	x	1.250	35.00	26.50	6450	421.4	660.4	81.7			1604.3	231	126.0	128.8	130.3	134.5	137.4	141.6
WT_ 610/406x32		16.0	x		40.00	26.50	7371	481.6	985.8	106.7			1833.5	264	143.0	145.8	147.2	151.5	154.4	158.6
WT_ 610/450x32		17.7	x		44.29	26.50	8162	533.2	1338.3	130.8			2030.2	292	157.5	160.4	161.8	166.1	168.9	173.2

Factored Shear Resistance Vr (kip)

Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
24	31.5	48.5	57.3	84.8	102.5	126.1

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web	Flange				Overall Depth	Section Properties				Factored Moment Resistance		Beam Weight					
		Width		Thickness	Area		Strong Axis		Weak Axis									
	h_w	b_f		t_f		d	I_x	S_x	I_y	S_y	M_r	L_u	WTA	WTB	WTC	WTF	WTH	WTK
	in	in		in	in^2	in	in^4	in^3	in^4	in^3	kip ft	in	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft
-	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*
WT_ 750/127x6	29.5	5.0	x	0.250	2.50	30.03	640	36.9	6.0	2.1	140.5	74	17.2	20.8	22.5	27.8	31.3	36.5
WT_ 750/152x6		6 x 0.250 **			2.69	30.03	689	39.7	7.5	2.4	151.3	80	18.9	22.4	24.2	29.5	33.0	38.2
WT_ 750/152x8		6.0	x	0.313	3.75	30.15	964	55.4	13.0	3.8	210.8	89	21.5	25.0	26.8	32.0	35.5	40.8
WT_ 750/152x10		6.0	x	0.375	4.50	30.28	1162	66.5	15.6	4.5	253.0	89	24.0	27.5	29.3	34.6	38.1	43.3
WT_ 750/178x10		7.0	x		5.25	30.28	1356	77.5	24.8	6.1	295.2	104	26.6	30.1	31.8	37.1	40.6	45.9
WT_ 750/152x13		6.0	x	0.500	6.00	30.53	1563	88.6	20.8	6.0	337.4	90	29.1	32.6	34.4	39.6	43.2	48.4
WT_ 750/178x13		7.0	x		7.00	30.53	1823	103.4	33.0	8.2	393.6	105	32.5	36.0	37.8	43.0	46.5	51.8
WT_ 750/203x13		8.0	x		8.00	30.53	2083	118.2	49.3	10.7	449.8	120	35.9	39.4	41.2	46.4	49.9	55.2
WT_ 750/152x19		6.0	x	0.750	9.00	31.03	2383	133.0	31.2	9.0	506.3	91	39.3	42.8	44.6	49.8	53.3	58.6
WT_ 750/203x16		8.0	x	0.625	10.00	30.78	2626	147.7	61.6	13.3	562.4	121	42.7	46.2	48.0	53.2	56.7	62.0
WT_ 750/203x19		8.0	x	0.750	12.00	31.03	3178	177.3	73.9	16.0	675.1	122	49.5	53.0	54.8	60.0	63.5	68.8
WT_ 750/254x19		10.0	x		15.00	31.03	3972	221.6	144.4	25.0	843.8	153	59.7	63.2	65.0	70.2	73.7	79.0
WT_ 750/203x25		8.0	x	1.000	16.00	31.53	4308	236.6	98.6	21.3	900.6	124	63.1	66.6	68.4	73.6	77.1	82.4
WT_ 750/254x25		10.0	x		20.00	31.53	5385	295.7	192.5	33.3	1125.8	156	76.7	80.2	81.9	87.2	90.7	95.9
WT_ 750/279x25		11.0	x		22.00	31.53	5923	325.3	256.3	40.3	1238.4	171	83.5	87.0	88.7	94.0	97.5	102.7
WT_ 750/305x25		12.0	x		24.00	31.53	6462	354.8	332.7	48.0	1351.0	187	90.3	93.8	95.5	100.8	104.3	109.5
WT_ 750/254x32		10.0	x	1.250	25.00	32.03	6843	369.9	240.7	41.7	1408.3	159	93.7	97.2	98.9	104.2	107.7	112.9
WT_ 750/330x25		13.0	x	1.000	26.00	31.53	7000	384.4	423.0	56.3	1463.5	202	97.1	100.6	102.3	107.6	111.1	116.3
WT_ 750/356x25		14.0	x		28.00	31.53	7539	414.0	528.3	65.3	1576.1	218	103.8	107.4	109.1	114.4	117.9	123.1
WT_ 750/305x32		12.0	x	1.250	30.00	32.03	8212	443.9	415.9	60.0	1690.0	191	110.6	114.1	115.9	121.2	124.7	129.9
WT_ 750/406x25		16.0	x	1.000	32.00	31.53	8616	473.1	788.6	85.3	1801.3	249	117.4	120.9	122.7	127.9	131.5	136.7
WT_ 750/356x32		14.0	x	1.250	35.00	32.03	9580	517.9	660.4	81.7	1971.7	223	127.6	131.1	132.9	138.1	141.6	146.9
WT_ 750/406x32		16.0	x		40.00	32.03	10949	591.9	985.8	106.7	2253.3	255	144.6	148.1	149.9	155.1	158.6	163.9
WT_ 750/450x32		17.7	x		44.29	32.03	12124	655.3	1338.3	130.8	2495.1	283	159.2	162.7	164.4	169.7	173.2	178.4

Factored Shear Resistance Vr (kip)						
Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	*cc*	*dd*	*ee*	*ff*	*gg*	*hh*
30	38.2	59.2	70.0	103.8	126.1	155.2

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w in	Flange Width b_f in		Flange Thickness t_f in	Area in^2	Overall Depth d in	Section Properties: Strong Axis I_x in^4	Strong Axis S_x in^3	Weak Axis I_y in^4	Weak Axis S_y in^3			Factored Moment Resistance M_r kip ft	L_u in	Beam Weight: WTA lb / ft	WTB lb / ft	WTC lb / ft	WTF lb / ft	WTH lb / ft	WTK lb / ft
-	a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
WT_900/127x6	35.4	5.0	x	0.250	2.50	35.93	919	44.3	6.0	2.1			168.6	74	19.0	23.2	25.3	31.6	35.8	42.1
WT_900/152x6		6 x 0.250**			2.69	35.93	990	47.7	7.5	2.4			181.5	80	20.7	24.9	27.0	33.3	37.5	43.8
WT_900/152x8		6.0	x	0.313	3.75	36.06	1384	66.4	13.0	3.8			253.0	89	23.2	27.4	29.6	35.9	40.1	46.4
WT_900/152x10		6.0	x	0.375	4.50	36.18	1666	79.7	15.6	4.5			303.6	89	25.8	30.0	32.1	38.4	42.6	48.9
WT_900/178x10		7.0	x		5.25	36.18	1944	93.0	24.8	6.1			354.2	104	28.3	32.5	34.7	41.0	45.2	51.5
WT_900/152x13		6.0	x	0.500	6.00	36.43	2238	106.3	20.8	6.0			404.8	89	30.9	35.1	37.2	43.5	47.7	54.0
WT_900/178x13		7.0	x		7.00	36.43	2611	124.0	33.0	8.2			472.3	104	34.3	38.5	40.6	46.9	51.1	57.4
WT_900/203x13		8.0	x		8.00	36.43	2983	141.8	49.3	10.7			539.7	119	37.7	41.9	44.0	50.3	54.5	60.8
WT_900/152x19		6.0	x	0.750	9.00	36.93	3404	159.5	31.2	9.0			607.4	91	41.1	45.3	47.4	53.7	57.9	64.2
WT_900/203x16		8.0	x	0.625	10.00	36.68	3755	177.2	61.6	13.3			674.8	120	44.5	48.7	50.8	57.1	61.3	67.6
WT_900/203x19		8.0	x	0.750	12.00	36.93	4538	212.7	73.9	16.0			809.9	121	51.3	55.5	57.6	63.9	68.1	74.4
WT_900/254x19		10.0	x		15.00	36.93	5673	265.9	144.4	25.0			1012.3	151	61.4	65.7	67.8	74.1	78.3	84.6
WT_900/203x25		8.0	x	1.000	16.00	37.43	6135	283.7	98.6	21.3			1080.3	123	64.8	69.1	71.2	77.5	81.7	88.0
WT_900/254x25		10.0	x		20.00	37.43	7669	354.7	192.5	33.3			1350.4	153	78.4	82.6	84.7	91.0	95.3	101.6
WT_900/279x25		11.0	x		22.00	37.43	8436	390.2	256.3	40.3			1485.4	169	85.2	89.4	91.5	97.8	102.0	108.3
WT_900/305x25		12.0	x		24.00	37.43	9203	425.6	332.7	48.0			1620.5	184	92.0	96.2	98.3	104.6	108.8	115.1
WT_900/254x32		10.0	x	1.250	25.00	37.93	9720	443.6	240.7	41.7			1688.9	156	95.4	99.6	101.7	108.0	112.2	118.5
WT_900/330x25		13.0	x	1.000	26.00	37.43	9970	461.1	423.0	56.3			1755.5	200	98.8	103.0	105.1	111.4	115.6	121.9
WT_900/356x25		14.0	x		28.00	37.43	10737	496.6	528.3	65.3			1890.5	215	105.6	109.8	111.9	118.2	122.4	128.7
WT_900/305x32		12.0	x	1.250	30.00	37.93	11664	532.3	415.9	60.0			2026.7	188	112.4	116.6	118.7	125.0	129.2	135.5
WT_900/406x25		16.0	x	1.000	32.00	37.43	12270	567.5	788.6	85.3			2160.6	246	119.2	123.4	125.5	131.8	136.0	142.3
WT_900/356x32		14.0	x	1.250	35.00	37.93	13607	621.0	660.4	81.7			2364.4	219	129.4	133.6	135.7	142.0	146.2	152.5
WT_900/406x32		16.0	x		40.00	37.93	15551	709.8	985.8	106.7			2702.2	250	146.4	150.6	152.7	159.0	163.2	169.5
WT_900/450x32		17.7	x		44.29	37.93	17220	785.9	1338.3	130.8			2992.1	277	160.9	165.1	167.2	173.5	177.7	184.0

Factored Shear Resistance Vr (kip): Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
35	45.3	70.5	83.5	124.0	151.3	186.2

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web	Flange Width		Flange Thickness	Flange Area	Overall Depth	Section Properties Strong Axis		Weak Axis				Factored Moment Resistance		Beam Weight WTA	WTB	WTC	WTF	WTH	WTK
	h_w	b_f		t_f		d	I_x	S_x	I_y	S_y			M_r	L_u						
	in	in		in	in^2	in	in^4	in^3	in^4	in^3			kip ft	in	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft
-	a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
WT_ 1000/127x6	39.4	5.0	x	0.250	2.50	39.87	1133	49.2	6.0	2.1			187.4	74	20.2	24.8	27.2	34.2	38.9	45.9
WT_ 1000/152x6		6 x 0.250 **			2.69	39.87	1220	53.0	7.5	2.4			201.7	79	21.9	26.5	28.9	35.9	40.6	47.6
WT_ 1000/152x8		6.0	x	0.313	3.75	40.00	1705	73.8	13.0	3.8			281.1	89	24.4	29.1	31.4	38.4	43.1	50.1
WT_ 1000/152x10		6.0	x	0.375	4.50	40.12	2053	88.6	15.6	4.5			337.3	89	27.0	31.6	34.0	41.0	45.7	52.7
WT_ 1000/178x10		7.0	x		5.25	40.12	2395	103.4	24.8	6.1			393.5	104	29.5	34.2	36.5	43.5	48.2	55.2
WT_ 1000/152x13		6.0	x	0.500	6.00	40.37	2755	118.1	20.8	6.0			449.8	89	32.1	36.7	39.1	46.1	50.7	57.7
WT_ 1000/178x13		7.0	x		7.00	40.37	3214	137.8	33.0	8.2			524.7	104	35.4	40.1	42.5	49.5	54.1	61.1
WT_ 1000/203x13		8.0	x		8.00	40.37	3673	157.5	49.3	10.7			599.7	119	38.8	43.5	45.9	52.9	57.5	64.5
WT_ 1000/152x19		6.0	x	0.750	9.00	40.87	4184	177.2	31.2	9.0			674.8	90	42.2	46.9	49.3	56.3	60.9	67.9
WT_ 1000/203x16		8.0	x	0.625	10.00	40.62	4620	196.9	61.6	13.3			749.7	120	45.6	50.3	52.7	59.7	64.3	71.3
WT_ 1000/203x19		8.0	x	0.750	12.00	40.87	5579	236.3	73.9	16.0			899.8	120	52.4	57.1	59.4	66.4	71.1	78.1
WT_ 1000/254x19		10.0	x		15.00	40.87	6974	295.4	144.4	25.0			1124.7	151	62.6	67.3	69.6	76.6	81.3	88.3
WT_ 1000/203x25		8.0	x	1.000	16.00	41.37	7532	315.2	98.6	21.3			1200.1	122	66.0	70.7	73.0	80.0	84.7	91.7
WT_ 1000/254x25		10.0	x		20.00	41.37	9416	394.0	192.5	33.3			1500.1	153	79.6	84.3	86.6	93.6	98.3	105.3
WT_ 1000/279x25		11.0	x		22.00	41.37	10357	433.4	256.3	40.3			1650.2	168	86.4	91.1	93.4	100.4	105.1	112.1
WT_ 1000/305x25		12.0	x		24.00	41.37	11299	472.8	332.7	48.0			1800.2	183	93.2	97.9	100.2	107.2	111.9	118.9
WT_ 1000/254x32		10.0	x	1.250	25.00	41.87	11917	492.7	240.7	41.7			1876.0	155	96.6	101.3	103.6	110.6	115.3	122.3
WT_ 1000/330x25		13.0	x	1.000	26.00	41.37	12240	512.2	423.0	56.3			1950.2	198	100.0	104.6	107.0	114.0	118.7	125.7
WT_ 1000/356x25		14.0	x		28.00	41.37	13182	551.6	528.3	65.3			2100.2	214	106.8	111.4	113.8	120.8	125.5	132.5
WT_ 1000/305x32		12.0	x	1.250	30.00	41.87	14300	591.3	415.9	60.0			2251.2	186	113.6	118.2	120.6	127.6	132.3	139.3
WT_ 1000/406x25		16.0	x	1.000	32.00	41.37	15065	630.4	788.6	85.3			2400.2	244	120.3	125.0	127.4	134.4	139.0	146.0
WT_ 1000/356x32		14.0	x	1.250	35.00	41.87	16684	689.8	660.4	81.7			2626.4	217	130.5	135.2	137.6	144.6	149.2	156.2
WT_ 1000/406x32		16.0	x		40.00	41.87	19067	788.4	985.8	106.7			3001.6	248	147.5	152.2	154.5	161.5	166.2	173.2
WT_ 1000/450x32		17.7	x		44.29	41.87	21113	873.0	1338.3	130.8			3323.6	275	162.1	166.8	169.1	176.1	180.8	187.8

Factored Shear Resistance Vr (kip) Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
39	50.1	78.1	92.4	137.5	168.1	206.9

SIN BEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w in	Flange Width b_f in		Flange Thickness t_f in	Flange Area in^2	Overall Depth d in	Section Properties Strong Axis I_x in^4	Section Properties Strong Axis S_x in^3	Section Properties Weak Axis I_y in^4	Section Properties Weak Axis S_y in^3			Factored Moment Resistance M_r kip ft	Factored Moment Resistance L_u in	Beam Weight WTA lb / ft	Beam Weight WTB lb / ft	Beam Weight WTC lb / ft	Beam Weight WTF lb / ft	Beam Weight WTH lb / ft	Beam Weight WTK lb / ft
-	a	b	c	d	e	f	g	h	i	j			m	n	p	q	r	s	t	u
WT_ 1219/127x6	48.0	5.0	x	0.250	2.50	48.50	1681	60.0	6.0	2.1			228.4	74	22.7	28.4	31.3	39.8	45.5	54.1
WT_ 1219/152x6		6 x 0.250 **			2.69	48.50	1809	64.6	7.5	2.4			245.9	79	24.4	30.1	33.0	41.5	47.2	55.8
WT_ 1219/152x8		6.0	x	0.313	3.75	48.63	2528	90.0	13.0	3.8			342.7	89	27.0	32.7	35.5	44.1	49.8	58.3
WT_ 1219/152x10		6.0	x	0.375	4.50	48.75	3041	108.0	15.6	4.5			411.2	89	29.5	35.2	38.1	46.6	52.3	60.8
WT_ 1219/178x10		7.0	x		5.25	48.75	3548	126.0	24.8	6.1			479.8	104	32.1	37.8	40.6	49.2	54.9	63.4
WT_ 1219/152x13		6.0	x	0.500	6.00	49.00	4076	144.0	20.8	6.0			548.3	89	34.6	40.3	43.2	51.7	57.4	65.9
WT_ 1219/178x13		7.0	x		7.00	49.00	4756	168.0	33.0	8.2			639.7	104	38.0	43.7	46.6	55.1	60.8	69.3
WT_ 1219/203x13		8.0	x		8.00	49.00	5435	192.0	49.3	10.7			731.1	119	41.4	47.1	50.0	58.5	64.2	72.7
WT_ 1219/152x19		6.0	x	0.750	9.00	49.50	6178	216.1	31.2	9.0			822.6	90	44.8	50.5	53.4	61.9	67.6	76.1
WT_ 1219/203x16		8.0	x	0.625	10.00	49.25	6829	240.1	61.6	13.3			913.9	119	48.2	53.9	56.8	65.3	71.0	79.5
WT_ 1219/203x19		8.0	x	0.750	12.00	49.50	8237	288.1	73.9	16.0			1096.8	120	55.0	60.7	63.5	72.1	77.8	86.3
WT_ 1219/254x19		10.0	x		15.00	49.50	10296	360.1	144.4	25.0			1371.0	150	65.2	70.9	73.7	82.3	88.0	96.5
WT_ 1219/203x25		8.0	x	1.000	16.00	50.00	11096	384.2	98.6	21.3			1462.8	121	68.6	74.3	77.1	85.7	91.4	99.9
WT_ 1219/254x25		10.0	x		20.00	50.00	13871	480.3	192.5	33.3			1828.5	151	82.2	87.9	90.7	99.2	104.9	113.5
WT_ 1219/279x25		11.0	x		22.00	50.00	15258	528.3	256.3	40.3			2011.3	166	88.9	94.6	97.5	106.0	111.7	120.3
WT_ 1219/305x25		12.0	x		24.00	50.00	16645	576.3	332.7	48.0			2194.2	181	95.7	101.4	104.3	112.8	118.5	127.1
WT_ 1219/254x32		10.0	x	1.250	25.00	50.50	17517	600.5	240.7	41.7			2286.3	153	99.1	104.8	107.7	116.2	121.9	130.5
WT_ 1219/330x25		13.0	x	1.000	26.00	50.00	18032	624.3	423.0	56.3			2377.0	197	102.5	108.2	111.1	119.6	125.3	133.9
WT_ 1219/356x25		14.0	x		28.00	50.00	19419	672.4	528.3	65.3			2559.9	212	109.3	115.0	117.9	126.4	132.1	140.7
WT_ 1219/305x32		12.0	x	1.250	30.00	50.50	21020	720.6	415.9	60.0			2743.6	183	116.1	121.8	124.7	133.2	138.9	147.4
WT_ 1219/406x25		16.0	x	1.000	32.00	50.00	22193	768.4	788.6	85.3			2925.6	242	122.9	128.6	131.5	140.0	145.7	154.2
WT_ 1219/356x32		14.0	x	1.250	35.00	50.50	24524	840.7	660.4	81.7			3200.8	214	133.1	138.8	141.7	150.2	155.9	164.4
WT_ 1219/406x32		16.0	x		40.00	50.50	28027	960.8	985.8	106.7			3658.1	245	150.1	155.8	158.6	167.2	172.9	181.4
WT_ 1219/450x32		17.7	x		44.29	50.50	31034	1063.9	1338.3	130.8			4050.5	271	164.7	170.3	173.2	181.7	187.4	196.0

Factored Shear Resistance Vr (kip)

Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
48	60.5	94.6	112.1	167.1	204.9	252.3

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web h_w in	Flange Width b_f in		Flange Thickness t_f in	Area in^2	Overall Depth d in	Section Properties Strong Axis I_x in^4	S_x in^3	Weak Axis I_y in^4	S_y in^3	Factored Moment Resistance M_r kip ft	L_u in	Beam Weight WTA lb / ft	WTB lb / ft	WTC lb / ft	WTF lb / ft	WTH lb / ft	WTK lb / ft
-	a	b	c	d	e	f	g	h	i	j	m	n	p	q	r	s	t	u
WT_ 1500/127x6	59.1	5.0	x	0.250	2.50	59.56	2539	73.8	6.0	2.1	281.1	74	26.0	33.0	36.5	47.0	54.0	64.5
WT_ 1500/152x6		6 x 0.250 **			2.69	59.56	2733	79.5	7.5	2.4	302.5	79	27.7	34.7	38.2	48.7	55.7	66.2
WT_ 1500/152x8		6.0	x	0.313	3.75	59.68	3817	110.7	13.0	3.8	421.6	89	30.2	37.3	40.8	51.3	58.3	68.8
WT_ 1500/152x10		6.0	x	0.375	4.50	59.81	4590	132.9	15.6	4.5	505.9	89	32.8	39.8	43.3	53.8	60.8	71.3
WT_ 1500/178x10		7.0	x		5.25	59.81	5355	155.0	24.8	6.1	590.2	104	35.3	42.4	45.9	56.4	63.4	73.9
WT_ 1500/152x13		6.0	x	0.500	6.00	60.06	6146	177.2	20.8	6.0	674.6	89	37.9	44.9	48.4	58.9	65.9	76.4
WT_ 1500/178x13		7.0	x		7.00	60.06	7171	206.7	33.0	8.2	787.0	104	41.3	48.3	51.8	62.3	69.3	79.8
WT_ 1500/203x13		8.0	x		8.00	60.06	8195	236.2	49.3	10.7	899.4	119	44.7	51.7	55.2	65.7	72.7	83.2
WT_ 1500/152x19		6.0	x	0.750	9.00	60.56	9297	265.8	31.2	9.0	1012.0	89	48.1	55.1	58.6	69.1	76.1	86.6
WT_ 1500/203x16		8.0	x	0.625	10.00	60.31	10287	295.3	61.6	13.3	1124.4	119	51.5	58.5	62.0	72.5	79.5	90.0
WT_ 1500/203x19		8.0	x	0.750	12.00	60.56	12396	354.4	73.9	16.0	1349.3	119	58.3	65.3	68.8	79.3	86.3	96.8
WT_ 1500/254x19		10.0	x		15.00	60.56	15495	443.0	144.4	25.0	1686.6	149	68.5	75.5	79.0	89.5	96.5	107.0
WT_ 1500/203x25		8.0	x	1.000	16.00	61.06	16668	472.6	98.6	21.3	1799.4	120	71.9	78.9	82.4	92.9	99.9	110.4
WT_ 1500/254x25		10.0	x		20.00	61.06	20834	590.8	192.5	33.3	2249.2	150	85.4	92.4	96.0	106.5	113.5	124.0
WT_ 1500/279x25		11.0	x		22.00	61.06	22918	649.8	256.3	40.3	2474.1	165	92.2	99.2	102.8	113.3	120.3	130.8
WT_ 1500/305x25		12.0	x		24.00	61.06	25001	708.9	332.7	48.0	2699.0	180	99.0	106.0	109.5	120.0	127.1	137.6
WT_ 1500/254x32		10.0	x	1.250	25.00	61.56	26262	738.6	240.7	41.7	2812.1	151	102.4	109.4	112.9	123.4	130.5	141.0
WT_ 1500/330x25		13.0	x	1.000	26.00	61.06	27085	768.0	423.0	56.3	2924.0	195	105.8	112.8	116.3	126.8	133.9	144.4
WT_ 1500/356x25		14.0	x		28.00	61.06	29168	827.1	528.3	65.3	3148.9	210	112.6	119.6	123.1	133.6	140.6	151.1
WT_ 1500/305x32		12.0	x	1.250	30.00	61.56	31514	886.3	415.9	60.0	3374.5	182	119.4	126.4	129.9	140.4	147.4	157.9
WT_ 1500/406x25		16.0	x	1.000	32.00	61.06	33335	945.2	788.6	85.3	3598.7	241	126.2	133.2	136.7	147.2	154.2	164.7
WT_ 1500/356x32		14.0	x	1.250	35.00	61.56	36766	1034.1	660.4	81.7	3936.9	212	136.4	143.4	146.9	157.4	164.4	174.9
WT_ 1500/406x32		16.0	x		40.00	61.56	42019	1181.8	985.8	106.7	4499.3	242	153.4	160.4	163.9	174.4	181.4	191.9
WT_ 1500/450x32		17.7	x		44.29	61.56	46526	1308.6	1338.3	130.8	4982.0	268	167.9	174.9	178.5	189.0	196.0	206.5

Factored Shear Resistance Vr (kip)

Depth	WTA	WTB	WTC	WTF	WTH	WTK
aa	cc	dd	ee	ff	gg	hh
59	63.2	100.8	130.8	201.4	251.5	310.4

Steelcon

SIN Beam Bending Properties

Imperial

SIN Size	Depth of Web	Flange				Overall Depth	Section Properties						Factored Moment Resistance		Beam Weight					
		Width		Thickness	Area		Strong Axis		Weak Axis						WTA	WTB	WTC	WTF	WTH	WTK
	h_w	b_f		t_f		d	I_x	S_x	I_y	S_y			M_r	L_u						
	in	in		in	in^2	in	in^4	in^3	in^4	in^3			kip ft	in	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft	lb / ft
-	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*			*m*	*n*	*p*	*q*	*r*	*s*	*t*	*u*

Notes

- \- SIN Beam sizes are indicated as WT[WEB THICKNESS] [WEB DEPTH] / [FLANGE WIDTH] x [FLANGE THICKNESS] - [WEIGHT]
  SIN Beam sizes are always indicated in Metric units
  i.e. For a 36in x 12ga web with 10in x 5/8in Flanges and a Weight of 58 lb/ft the designation is WTB915 / 254x16 - 86.5
- \- Flanges and Webs are all fabricated from W350 Material (Fy = 350MPa)
- \- Flanges of over 5/8in (16mm) in thickness will include a premium due to the required splicing of the flat bar
- ** 152x6 Section Properties and Moment resistance based on a flange width of 136mm to be Class 3

a	Depth of the Beam web, i.e. Inside of flanges
b	Width of top and bottom flange
d	Thickess of top and bottom flange
e	Cross sectionional area of flanges only (web is neglected)
f	Overall depth of section
g	Strong Axis Moment of Inertia computed using flange properties only
h	Strong Axis Section Modulas computed using flange properties only
i	Weak Axis Moment of Inertia computed using flange properties only
j	Weak Axis Section Modulas computed using flange properties only
m	Strong Axis Factored Moment Restance assuming compression flange is fully braced based on CSA S16
n	Maximum unbraced lenght for which Mr is applicable
o - u	Mass of member per unit length with a web thickess of 16ga (1.519mm); 14ga (1.897mm); 12ga; 11ga; 8ga; 6ga; 3ga
aa	Depth of Beam web
bb - hh	Shear Capacity for a 16 ga (1.519mm); 14ga; 12ga; 11ga; 8ga; 6ga; 3ga web

SIN Beam Shear

Metric

Constants

ν	0.3	Poissons Ratio
E	200 GPa	Youngs Modulas
Fy web	350 MPa	Web Material Yield Strength
ϕs	0.75	Material Resistance Factor (Per CSA S136)

Shear Capacity

Designation	Web Depth	t_w	Shear Distortion Area	Local Buckling (EN)			Global Buckling			Factored Shear Resistance
				$\tau_{cr.l}$	$\lambda_{cr.l}$	$\chi_{cr.l}$	$\tau_{cr.g}$	$\lambda_{cr.g}$	$\chi_{cr.g}$	
	mm	mm	mm^2	MPa			MPa			Vr (kN)
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
WTA333	333	1.90	550	901.6	0.473	0.84	2277.2	0.298	1.00	80.2
WTB333	333	2.66	770	1508.4	0.366	0.91	2697.8	0.274	1.00	121.8
WTC333	333	3.04	857	1867.9	0.329	0.94	3202.2	0.251	1.00	143.5
WTF333	333	4.18	1178	3126.3	0.254	1.00	3762.5	0.232	1.00	210.0
WTH333	333	4.94	1392	4135.7	0.221	1.00	4098.0	0.222	1.00	249.1
WTK333	333	6.07	1713	5901.9	0.185	1.00	4561.1	0.210	1.00	306.5
WTA440	440	1.90	727	789.0	0.506	0.82	1304.3	0.394	1.00	103.5
WTB440	440	2.66	1018	1350.8	0.387	0.89	1545.2	0.362	1.00	158.3
WTC440	440	3.04	1132	1677.6	0.347	0.92	1834.1	0.332	1.00	186.8
WTF440	440	4.18	1556	2864.7	0.266	0.99	2155.1	0.306	1.00	274.7
WTH440	440	4.94	1839	3826.5	0.230	1.00	2347.2	0.293	1.00	329.1
WTK440	440	6.07	2263	5521.4	0.191	1.00	2612.5	0.278	1.00	405.0
WTA500	500	1.90	826	747.0	0.520	0.81	1010.1	0.447	1.00	116.4
WTB500	500	2.66	1157	1291.9	0.395	0.89	1196.6	0.411	1.00	178.7
WTC500	500	3.04	1287	1606.5	0.355	0.92	1420.4	0.377	1.00	211.0
WTF500	500	4.18	1768	2767.0	0.270	0.98	1668.9	0.348	1.00	311.0
WTH500	500	4.94	2090	3711.0	0.233	1.00	1817.7	0.333	1.00	374.0
WTK500	500	6.07	2572	5379.3	0.194	1.00	2023.1	0.316	1.00	460.2
WTA610	610	1.90	1007	691.6	0.541	0.80	679.5	0.545	1.00	139.9
WTB610	610	2.66	1410	1214.3	0.408	0.88	805.0	0.501	1.00	215.8
WTC610	610	3.04	1569	1512.8	0.365	0.91	955.5	0.460	1.00	255.0
WTF610	610	4.18	2156	2638.2	0.277	0.98	1122.7	0.424	1.00	377.0
WTH610	610	4.94	2548	3558.8	0.238	1.00	1222.8	0.407	1.00	456.0
WTK610	610	6.07	3136	5192.0	0.197	1.00	1361.0	0.385	1.00	561.1
WTA750	750	1.90	1239	644.2	0.560	0.79	448.9	0.671	1.00	169.9
WTB750	750	2.66	1735	1148.0	0.420	0.87	531.8	0.616	1.00	263.2
WTC750	750	3.04	1930	1432.7	0.376	0.90	631.3	0.566	1.00	311.3
WTF750	750	4.18	2653	2528.2	0.283	0.97	741.7	0.522	1.00	461.5
WTH750	750	4.94	3135	3428.7	0.243	1.00	807.9	0.500	1.00	561.0
WTK750	750	6.07	3858	5032.0	0.200	1.00	899.2	0.474	1.00	690.3
WTA900	900	1.90	1487	610.0	0.576	0.78	311.8	0.805	1.00	201.7
WTB900	900	2.66	2082	1100.0	0.429	0.87	369.3	0.740	1.00	313.7
WTC900	900	3.04	2316	1374.8	0.383	0.90	438.4	0.679	1.00	371.3
WTF900	900	4.18	3183	2448.6	0.287	0.97	515.1	0.626	1.00	551.7
WTH900	900	4.94	3762	3334.7	0.246	1.00	561.0	0.600	1.00	673.2
WTK900	900	6.07	4630	4916.2	0.203	1.00	624.4	0.569	1.00	828.4

SIN Beam Shear

Metric

Constants

ν	0.3	Poissons Ratio
E	200 GPa	Youngs Modulas
Fy web	350 MPa	Web Material Yield Strength
ϕs	0.75	Material Resistance Factor (Per CSA S136)

Shear Capacity

Designation	Web Depth mm	t_w mm	Shear Distortion Area mm^2	Local Buckling (EN) $\tau_{cr.l}$ MPa	$\lambda_{cr.l}$	$\chi_{cr.l}$	Global Buckling $\tau_{cr.g}$ MPa	$\lambda_{cr.g}$	$\chi_{cr.g}$	Factored Shear Resistance Vr (kN)
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
WTA1000	1000	1.90	1652	592.9	0.584	0.78	252.5	0.895	1.00	222.9
WTB1000	1000	2.66	2314	1076.0	0.433	0.86	299.2	0.822	1.00	347.3
WTC1000	1000	3.04	2573	1345.9	0.387	0.89	355.1	0.754	1.00	411.2
WTF1000	1000	4.18	3537	2408.8	0.290	0.97	417.2	0.696	1.00	611.8
WTH1000	1000	4.94	4180	3287.6	0.248	1.00	454.4	0.667	1.00	748.0
WTK1000	1000	6.07	5144	4858.3	0.204	1.00	505.8	0.632	1.00	920.4
WTA1219	1219	1.90	2014	565.1	0.598	0.77	169.9	1.091	0.89	269.1
WTB1219	1219	2.66	2821	1037.2	0.441	0.86	201.3	1.002	1.00	420.9
WTC1219	1219	3.04	3137	1299.0	0.394	0.89	238.9	0.920	1.00	498.7
WTF1219	1219	4.18	4312	2344.4	0.294	0.96	280.7	0.848	1.00	743.4
WTH1219	1219	4.94	5096	3211.5	0.251	1.00	305.7	0.813	1.00	911.2
WTK1219	1219	6.07	6271	4764.6	0.206	1.00	340.3	0.771	1.00	1122.2
WTA1500	1500	1.90	2478	541.5	0.611	0.76	112.2	1.342	0.65	281.2
WTB1500	1500	2.66	3470	1004.1	0.449	0.85	133.0	1.233	0.74	448.5
WTC1500	1500	3.04	3860	1259.0	0.401	0.88	157.8	1.132	0.84	581.8
WTF1500	1500	4.18	5305	2289.3	0.297	0.96	185.4	1.044	0.94	895.7
WTH1500	1500	4.94	6270	3146.5	0.253	1.00	202.0	1.000	1.00	1118.6
WTK1500	1500	6.07	7716	4684.6	0.208	1.00	224.8	0.948	1.00	1380.6

Physical Properties

Designation	t_w ga	t_w mm	a_3 mm	w mm	s mm	Iz mm^4	Dx kN m	Dz kN m
WTA	14	1.90	40	77.5	89	29450	0.109	76.0
WTB	12	2.66	40	77.5	89	41300	0.299	106.6
WTC	11	3.04	43	77.5	90.6	54600	0.439	140.9
WTF	8	4.18	43	77.5	90.6	75270	1.141	194.2
WTH	6	4.94	43	77.5	90.6	89180	1.883	230.1
WTK	3	6.07	43	77.5	90.6	110230	3.509	284.5

SIN Beam Shear

Imperial

Constants

ν	0.3	Poissons Ratio
E	29008 ksi	Youngs Modulas
Fy web	51 ksi	Web Material Yield Strength
ϕs	0.75	Material Resistance Factor (Per CSA S136)

Shear Capacity

Designation	Web Depth (in)	t_{web} (in)	Shear Distortion Area (in^2)	Local Buckling (EN) $\tau_{cr.l}$ (ksi)	Local Buckling (EN) $\lambda_{cr.l}$	Local Buckling (EN) $\chi_{cr.l}$	Global Buckling $\tau_{cr.g}$ (ksi)	Global Buckling $\lambda_{cr.g}$	Global Buckling $\chi_{cr.g}$	Factored Shear Resistance Vr (kip)
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
WTA333	13.11	0.075	0.853	130.8	0.473	0.84	330.3	0.298	1.00	18.0
WTB333	13.11	0.105	1.194	218.8	0.366	0.91	391.3	0.274	1.00	27.4
WTC333	13.11	0.120	1.328	270.9	0.329	0.94	464.4	0.251	1.00	32.3
WTF333	13.11	0.164	1.826	453.4	0.254	1.00	545.7	0.232	1.00	47.2
WTH333	13.11	0.194	2.158	599.8	0.221	1.00	594.4	0.222	1.00	56.0
WTK333	13.11	0.239	2.655	856.0	0.185	1.00	661.5	0.210	1.00	68.9
WTA440	17.32	0.075	1.127	114.4	0.506	0.82	189.2	0.394	1.00	23.3
WTB440	17.32	0.105	1.578	195.9	0.387	0.89	224.1	0.362	1.00	35.6
WTC440	17.32	0.120	1.755	243.3	0.347	0.92	266.0	0.332	1.00	42.0
WTF440	17.32	0.164	2.412	415.5	0.266	0.99	312.6	0.306	1.00	61.8
WTH440	17.32	0.194	2.851	555.0	0.230	1.00	340.4	0.293	1.00	74.0
WTK440	17.32	0.239	3.508	800.8	0.191	1.00	378.9	0.278	1.00	91.0
WTA500	19.69	0.075	1.280	108.3	0.520	0.81	146.5	0.447	1.00	26.2
WTB500	19.69	0.105	1.793	187.4	0.395	0.89	173.6	0.411	1.00	40.2
WTC500	19.69	0.120	1.994	233.0	0.355	0.92	206.0	0.377	1.00	47.4
WTF500	19.69	0.164	2.741	401.3	0.270	0.98	242.1	0.348	1.00	69.9
WTH500	19.69	0.194	3.240	538.2	0.233	1.00	263.6	0.333	1.00	84.1
WTK500	19.69	0.239	3.987	780.2	0.194	1.00	293.4	0.316	1.00	103.5
WTA610	24.00	0.075	1.561	100.3	0.541	0.80	98.6	0.545	1.00	31.5
WTB610	24.00	0.105	2.186	176.1	0.408	0.88	116.8	0.501	1.00	48.5
WTC610	24.00	0.120	2.431	219.4	0.365	0.91	138.6	0.460	1.00	57.3
WTF610	24.00	0.164	3.342	382.6	0.277	0.98	162.8	0.424	1.00	84.8
WTH610	24.00	0.194	3.950	516.2	0.238	1.00	177.4	0.407	1.00	102.5
WTK610	24.00	0.239	4.860	753.0	0.197	1.00	197.4	0.385	1.00	126.1
WTA750	29.53	0.075	1.921	93.4	0.560	0.79	65.1	0.671	1.00	38.2
WTB750	29.53	0.105	2.689	166.5	0.420	0.87	77.1	0.616	1.00	59.2
WTC750	29.53	0.120	2.991	207.8	0.376	0.90	91.6	0.566	1.00	70.0
WTF750	29.53	0.164	4.112	366.7	0.283	0.97	107.6	0.522	1.00	103.8
WTH750	29.53	0.194	4.859	497.3	0.243	1.00	117.2	0.500	1.00	126.1
WTK750	29.53	0.239	5.980	729.8	0.200	1.00	130.4	0.474	1.00	155.2
WTA900	35.43	0.075	2.305	88.5	0.576	0.78	45.2	0.805	1.00	45.3
WTB900	35.43	0.105	3.227	159.5	0.429	0.87	53.6	0.740	1.00	70.5
WTC900	35.43	0.120	3.589	199.4	0.383	0.90	63.6	0.679	1.00	83.5
WTF900	35.43	0.164	4.934	355.1	0.287	0.97	74.7	0.626	1.00	124.0
WTH900	35.43	0.194	5.831	483.7	0.246	1.00	81.4	0.600	1.00	151.3
WTK900	35.43	0.239	7.176	713.0	0.203	1.00	90.6	0.569	1.00	186.2

SIN BEAM
LIGHTER BY DESIGN

SIN Beam Shear

Imperial

Constants

ν	0.3	Poissons Ratio
E	29008 ksi	Youngs Modulas
Fy web	51 ksi	Web Material Yield Strength
ϕs	0.75	Material Resistance Factor (Per CSA S136)

Shear Capacity

Designation	Web Depth	t web	Shear Distortion Area	Local Buckling (EN)			Global Buckling			Factored Shear Resistance
				$\tau_{cr.l}$	$\lambda_{cr.l}$	$\chi_{cr.l}$	$\tau_{cr.g}$	$\lambda_{cr.g}$	$\chi_{cr.g}$	
	in	in	in^2	ksi			ksi			Vr (kip)
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
WTA1000	39.37	0.075	2.561	86.0	0.584	0.78	36.6	0.895	1.00	50.1
WTB1000	39.37	0.105	3.586	156.1	0.433	0.86	43.4	0.822	1.00	78.1
WTC1000	39.37	0.120	3.988	195.2	0.387	0.89	51.5	0.754	1.00	92.4
WTF1000	39.37	0.164	5.482	349.4	0.290	0.97	60.5	0.696	1.00	137.5
WTH1000	39.37	0.194	6.479	476.8	0.248	1.00	65.9	0.667	1.00	168.1
WTK1000	39.37	0.239	7.973	704.6	0.204	1.00	73.4	0.632	1.00	206.9
WTA1219	48.00	0.075	3.122	82.0	0.598	0.77	24.6	1.091	0.89	60.5
WTB1219	48.00	0.105	4.372	150.4	0.441	0.86	29.2	1.002	1.00	94.6
WTC1219	48.00	0.120	4.862	188.4	0.394	0.89	34.6	0.920	1.00	112.1
WTF1219	48.00	0.164	6.684	340.0	0.294	0.96	40.7	0.848	1.00	167.1
WTH1219	48.00	0.194	7.899	465.8	0.251	1.00	44.3	0.813	1.00	204.9
WTK1219	48.00	0.239	9.721	691.1	0.206	1.00	49.4	0.771	1.00	252.3
WTA1500	59.06	0.075	3.841	78.5	0.611	0.76	16.3	1.342	0.65	63.2
WTB1500	59.06	0.105	5.379	145.6	0.449	0.85	19.3	1.233	0.74	100.8
WTC1500	59.06	0.120	5.982	182.6	0.401	0.88	22.9	1.132	0.84	130.8
WTF1500	59.06	0.164	8.223	332.0	0.297	0.96	26.9	1.044	0.94	201.4
WTH1500	59.06	0.194	9.719	456.4	0.253	1.00	29.3	1.000	1.00	251.5
WTK1500	59.06	0.239	11.960	679.5	0.208	1.00	32.6	0.948	1.00	310.4

Physical Properties

Designation	t_w	t_w	a_3	w	s	Iz	Dx	Dz
	ga	in	in	in	in	in^4	kip ft	kip ft
WTA	14	0.075	1.57	3.05	3.50	0.0708	0.0075	5.21
WTB	12	0.105	1.57	3.05	3.50	0.0992	0.0205	7.30
WTC	11	0.120	1.69	3.05	3.57	0.1312	0.0301	9.65
WTF	8	0.164	1.69	3.05	3.57	0.1808	0.0782	13.31
WTH	6	0.194	1.69	3.05	3.57	0.2143	0.1290	15.77
WTK	3	0.239	1.69	3.05	3.57	0.2648	0.2405	19.49

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web	Flange			Area			Factored Compressive Resistance Cr (kN) Effective length (mm) with respect to least radius of gyration (r_y)													
h_w (mm)	Width b_f (mm)		Thickness t_f (mm)	(mm^2)	r_y (mm)	r_x/r_y	0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
333	127	x	6	1612.9	36.7	4.63	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	3.86	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	3.88	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	3.89	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	3.34	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	3.93	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	3.37	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	2.95	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	4.00	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	2.97	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	3.00	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	2.40	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	3.06	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	2.45	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	2.22	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	2.04	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	2.49	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	1.88	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	1.75	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	2.08	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	1.53	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	1.78	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	1.56	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	1.41	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm^2)	r_y (mm)	r_x/r_y	Factored Compressive Resistance Cr (kN) — Effective length (mm) with respect to least radius of gyration (r_y): 0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
440	127	x	6	1612.9	36.7	6.09	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	5.07	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	5.09	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	5.11	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	4.38	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	5.15	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	4.41	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	3.86	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	5.22	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	3.89	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	3.91	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	3.13	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	3.97	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	3.18	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	2.89	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	2.65	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	3.22	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	2.44	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	2.27	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	2.68	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	1.98	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	2.30	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	2.01	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	1.82	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SIN Beam Axial Capacity

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm^2)	r_y (mm)	r_x/r_y	Factored Compressive Resistance Cr (kN) — Effective length (mm) with respect to least radius of gyration (r_y): 0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
500	127	x	6	1612.9	36.7	6.91	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	5.75	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	5.77	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	5.79	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	4.96	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	5.83	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	5.00	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	4.37	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	5.90	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	4.40	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	4.43	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	3.54	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	4.48	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	3.58	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	3.26	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	2.99	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	3.63	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	2.76	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	2.56	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	3.02	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	2.24	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	2.59	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	2.27	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	2.05	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SIN Beam Axial Capacity

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm^2)	r_y (mm)	r_x/r_y	Factored Compressive Resistance Cr (kN) Effective length (mm) with respect to least radius of gyration (r_y) 0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
610	127	x	6	1612.9	36.7	8.40	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	7.00	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	7.02	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	7.04	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	6.03	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	7.07	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	6.06	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	5.30	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	7.15	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	5.33	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	5.36	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	4.29	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	5.41	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	4.33	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	3.94	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	3.61	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	4.38	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	3.33	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	3.09	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	3.65	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	2.71	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	3.13	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	2.73	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	2.47	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web	Flange			Area			Factored Compressive Resistance Cr (kN) Effective length (mm) with respect to least radius of gyration (r_y)													
	Width		Thickness																	
h_w	b_f		t_f		r_y	r_x/r_y	0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
(mm)	(mm)		(mm)	(mm^2)	(mm)															
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
750	127	x	6	1612.9	36.7	10.32	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	8.60	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	8.61	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	8.63	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	7.40	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	8.67	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	7.43	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	6.50	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	8.74	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	6.53	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	6.56	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	5.24	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	6.61	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	5.29	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	4.81	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	4.41	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	5.33	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	4.07	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	3.78	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	4.44	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	3.31	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	3.81	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	3.33	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	3.01	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SIN Beam Axial Capacity

Metric

Depth of Web	Flange			Area			Factored Compressive Resistance Cr (kN)													
	Width		Thickness				Effective length (mm) with respect to least radius of gyration (r_y)													
h_w	b_f		t_f		r_y	r_x/r_y	0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
(mm)	(mm)		(mm)	(mm^2)	(mm)															
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
900	127	x	6	1612.9	36.7	12.36	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	10.30	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	10.32	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	10.34	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	8.86	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	10.37	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	8.89	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	7.78	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	10.45	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	7.81	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	7.83	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	6.27	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	7.89	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	6.31	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	5.74	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	5.26	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	6.35	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	4.85	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	4.51	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	5.30	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	3.94	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	4.54	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	3.97	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	3.59	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web	Flange			Area			Factored Compressive Resistance Cr (kN) Effective length (mm) with respect to least radius of gyration (r_y)													
h_w (mm)	Width b_f (mm)		Thickness t_f (mm)	(mm^2)	r_y (mm)	r_x/r_y	0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
1000	127	x	6	1612.9	36.7	13.72	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	11.44	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	11.46	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	11.47	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	9.83	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	11.51	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	9.87	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	8.63	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	11.58	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	8.66	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	8.69	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	6.95	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	8.74	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	6.99	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	6.36	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	5.83	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	7.04	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	5.38	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	5.00	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	5.86	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	4.37	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	5.03	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	4.40	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	3.97	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm^2)	r_y (mm)	r_x/r_y	Factored Compressive Resistance Cr (kN) Effective length (mm) with respect to least radius of gyration (r_y)													
							0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
1219	127	x	6	1612.9	36.7	16.71	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	13.93	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	13.95	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	13.96	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	11.97	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	14.00	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	12.00	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	10.50	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	14.07	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	10.53	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	10.56	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	8.44	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	10.61	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	8.49	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	7.72	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	7.07	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	8.53	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	6.53	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	6.06	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	7.11	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	5.30	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	6.09	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	5.33	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	4.82	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Metric

Depth of Web h_w (mm)	Flange Width b_f (mm)		Flange Thickness t_f (mm)	Area (mm^2)	r_y (mm)	r_x/r_y	Factored Compressive Resistance Cr (kN) — Effective length (mm) with respect to least radius of gyration (r_y): 0	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	13000	15000	18000
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	t2
1500	127	x	6	1612.9	36.7	20.54	508.1	390.1	276.6	190.6	134.3	98.0	74.1	57.7	46.1	37.6	31.3	22.5	17.0	11.8
	152	x		1935.48	44.0	17.12	609.7	512.9	397.8	293.0	215.2	161.1	123.7	97.3	78.2	64.1	53.4	38.6	29.2	20.4
	152	x	8	2419.35	44.0	17.14	762.1	641.2	497.2	366.3	269.1	201.4	154.6	121.6	97.8	80.1	66.8	48.3	36.5	25.5
	152	x	10	2903.22	44.0	17.16	914.5	769.4	596.7	439.5	322.9	241.7	185.5	145.9	117.3	96.2	80.1	58.0	43.8	30.6
	178	x		3387.09	51.3	14.71	1066.9	947.6	784.1	612.4	469.0	360.9	282.0	224.4	181.9	149.9	125.4	91.2	69.1	48.3
	152	x	13	3870.96	44.0	17.19	1219.4	1025.9	795.6	586.0	430.5	322.3	247.4	194.6	156.4	128.2	106.8	77.3	58.4	40.8
	178	x		4516.12	51.3	14.74	1422.6	1263.4	1045.5	816.5	625.3	481.2	376.0	299.2	242.5	199.9	167.2	121.6	92.1	64.5
	203	x		5161.28	58.7	12.89	1625.8	1493.5	1294.5	1060.8	844.8	668.7	532.7	429.7	351.5	291.6	245.2	179.4	136.4	95.7
	152	x	19	5806.44	44.0	17.26	1829.0	1538.8	1193.4	879.1	645.7	483.4	371.0	291.8	234.6	192.3	160.3	115.9	87.6	61.1
	203	x	16	6451.6	58.7	12.92	2032.3	1866.8	1618.1	1326.0	1056.0	835.8	665.9	537.1	439.4	364.5	306.4	224.2	170.5	119.7
	203	x	19	7741.92	58.7	12.95	2438.7	2240.2	1941.7	1591.2	1267.2	1003.0	799.1	644.5	527.3	437.5	367.7	269.1	204.6	143.6
	254	x		9677.4	73.3	10.36	3048.4	2905.9	2666.6	2340.8	1988.9	1659.6	1376.3	1143.4	955.8	805.7	685.3	509.4	391.1	276.7
	203	x	25	10322.56	58.7	13.00	3251.6	2986.9	2588.9	2121.5	1689.7	1337.3	1065.5	859.4	703.0	583.3	490.3	358.7	272.8	191.5
	254	x		12903.2	73.3	10.40	4064.5	3874.5	3555.4	3121.1	2651.9	2212.8	1835.1	1524.5	1274.4	1074.2	913.8	679.2	521.4	368.9
	279	x		14193.52	80.7	9.46	4471.0	4307.1	4022.6	3616.1	3151.1	2690.5	2274.4	1918.3	1622.3	1379.7	1181.7	886.5	684.6	486.8
	305	x		15483.84	88.0	8.67	4877.4	4734.5	4480.4	4103.6	3651.9	3182.3	2738.6	2344.1	2006.0	1721.9	1485.4	1125.8	874.9	625.7
	254	x	32	16129	73.3	10.45	5080.6	4843.1	4444.3	3901.4	3314.9	2766.0	2293.9	1905.7	1593.0	1342.8	1142.2	848.9	651.8	461.1
	330	x	25	16774.16	95.3	8.00	5283.9	5158.1	4930.4	4582.7	4149.9	3681.2	3220.1	2795.4	2420.2	2097.2	1822.9	1396.5	1092.9	786.6
	356	x		18064.48	102.7	7.43	5690.3	5578.7	5373.8	5053.7	4642.8	4182.1	3712.7	3265.9	2859.7	2501.4	2191.0	1697.6	1338.5	970.1
	305	x	32	19354.8	88.0	8.70	6096.8	5918.2	5600.5	5129.5	4564.8	3977.9	3423.3	2930.2	2507.5	2152.4	1856.8	1407.2	1093.6	782.1
	406	x	25	20645.12	117.3	6.50	6503.2	6413.4	6245.3	5973.9	5609.4	5177.9	4712.1	4243.1	3794.0	3379.3	3005.7	2384.3	1910.5	1406.1
	356	x	32	22580.6	102.7	7.46	7112.9	6973.4	6717.2	6317.1	5803.6	5227.6	4640.9	4082.3	3574.6	3126.7	2738.7	2122.0	1673.2	1212.6
	406	x		25806.4	117.3	6.53	8129.0	8016.8	7806.6	7467.4	7011.8	6472.3	5890.2	5303.9	4742.5	4224.1	3757.2	2980.3	2388.1	1757.6
	450	x		28575	129.9	5.90	9001.1	8906.2	8726.4	8430.7	8022.6	7522.7	6962.2	6375.1	5791.2	5232.7	4713.4	3815.4	3102.4	2316.8

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SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Area (in2)	r_y (in)	r_x/r_y	Factored Compressive Resistance Vr (kip), Effective length (ft) with respect to least radius of gyration (r_y): 0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
WT_ 333/127x6	13.1	5.0	x	1/4	2.50	1.44	4.63	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 333/152x6		6.0	x		3.00	1.73	3.86	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 333/152x8		6.0	x	5/16	3.75	1.73	3.88	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 333/152x10		6.0	x	3/8	4.50	1.73	3.89	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 333/178x10		7.0	x		5.25	2.02	3.34	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 333/152x13		6.0	x	1/2	6.00	1.73	3.93	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 333/178x13		7.0	x		7.00	2.02	3.37	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 333/203x13		8.0	x		8.00	2.31	2.95	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 333/152x19		6.0	x	3/4	9.00	1.73	4.00	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 333/203x16		8.0	x	5/8	10.00	2.31	2.97	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 333/203x19		8.0	x	3/4	12.00	2.31	3.00	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 333/254x19		10.0	x		15.00	2.89	2.40	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 333/203x25		8.0	x	1	16.00	2.31	3.06	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 333/254x25		10.0	x		20.00	2.89	2.45	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 333/279x25		11.0	x		22.00	3.18	2.22	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 333/305x25		12.0	x		24.00	3.46	2.04	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 333/254x32		10.0	x	1 1/4	25.00	2.89	2.49	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 333/330x25		13.0	x	1	26.00	3.75	1.88	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 333/356x25		14.0	x		28.00	4.04	1.75	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 333/305x32		12.0	x	1 1/4	30.00	3.46	2.08	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 333/406x25		16.0	x	1	32.00	4.62	1.53	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 333/356x32		14.0	x	1 1/4	35.00	4.04	1.78	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 333/406x32		16.0	x		40.00	4.62	1.56	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 333/450x32		17.7	x		44.29	5.11	1.41	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Area (in2)	r_y (in)	r_x/r_y	Factored Compressive Resistance Vr (kip) — Effective length (ft) with respect to least radius of gyration (r_y): 0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
WT_ 440/127x6	17.3	5.0	x	1/4	2.50	1.44	6.09	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 440/152x6		6.0	x		3.00	1.73	5.07	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 440/152x8		6.0	x	5/16	3.75	1.73	5.09	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 440/152x10		6.0	x	3/8	4.50	1.73	5.11	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 440/178x10		7.0	x		5.25	2.02	4.38	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 440/152x13		6.0	x	1/2	6.00	1.73	5.15	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 440/178x13		7.0	x		7.00	2.02	4.41	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 440/203x13		8.0	x		8.00	2.31	3.86	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 440/152x19		6.0	x	3/4	9.00	1.73	5.22	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 440/203x16		8.0	x	5/8	10.00	2.31	3.89	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 440/203x19		8.0	x	3/4	12.00	2.31	3.91	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 440/254x19		10.0	x		15.00	2.89	3.13	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 440/203x25		8.0	x	1	16.00	2.31	3.97	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 440/254x25		10.0	x		20.00	2.89	3.18	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 440/279x25		11.0	x		22.00	3.18	2.89	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 440/305x25		12.0	x		24.00	3.46	2.65	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 440/254x32		10.0	x	1 1/4	25.00	2.89	3.22	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 440/330x25		13.0	x	1	26.00	3.75	2.44	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 440/356x25		14.0	x		28.00	4.04	2.27	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 440/305x32		12.0	x	1 1/4	30.00	3.46	2.68	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 440/406x25		16.0	x	1	32.00	4.62	1.98	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 440/356x32		14.0	x	1 1/4	35.00	4.04	2.30	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 440/406x32		16.0	x		40.00	4.62	2.01	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 440/450x32		17.7	x		44.29	5.11	1.82	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Area (in2)	r_y (in)	r_x/r_y	Factored Compressive Resistance Vr (kip) — Effective length (ft) with respect to least radius of gyration (r_y): 0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
WT_500/127x6	19.7	5.0	x	1/4	2.50	1.44	6.91	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_500/152x6		6.0	x		3.00	1.73	5.75	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_500/152x8		6.0	x	5/16	3.75	1.73	5.77	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_500/152x10		6.0	x	3/8	4.50	1.73	5.79	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_500/178x10		7.0	x		5.25	2.02	4.96	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_500/152x13		6.0	x	1/2	6.00	1.73	5.83	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_500/178x13		7.0	x		7.00	2.02	5.00	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_500/203x13		8.0	x		8.00	2.31	4.37	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_500/152x19		6.0	x	3/4	9.00	1.73	5.90	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_500/203x16		8.0	x	5/8	10.00	2.31	4.40	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_500/203x19		8.0	x	3/4	12.00	2.31	4.43	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_500/254x19		10.0	x		15.00	2.89	3.54	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_500/203x25		8.0	x	1	16.00	2.31	4.48	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_500/254x25		10.0	x		20.00	2.89	3.58	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_500/279x25		11.0	x		22.00	3.18	3.26	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_500/305x25		12.0	x		24.00	3.46	2.99	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_500/254x32		10.0	x	1 1/4	25.00	2.89	3.63	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_500/330x25		13.0	x	1	26.00	3.75	2.76	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_500/356x25		14.0	x		28.00	4.04	2.56	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_500/305x32		12.0	x	1 1/4	30.00	3.46	3.02	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_500/406x25		16.0	x	1	32.00	4.62	2.24	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_500/356x32		14.0	x	1 1/4	35.00	4.04	2.59	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_500/406x32		16.0	x		40.00	4.62	2.27	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_500/450x32		17.7	x		44.29	5.11	2.05	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web	Flange Width		Flange Thickness	Area			Factored Compressive Resistance Vr (kip) Effective length (ft) with respect to least radius of gyration (r_y)													
	h_w (in)	b_f (in)		t_f (in)	(in2)	r_y (in)	r_x/r_y	0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*	*t*	*u*
WT_ 610/127x6	24.0	5.0	x	1/4	2.50	1.44	8.40	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 610/152x6		6.0	x		3.00	1.73	7.00	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 610/152x8		6.0	x	5/16	3.75	1.73	7.02	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 610/152x10		6.0	x	3/8	4.50	1.73	7.04	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 610/178x10		7.0	x		5.25	2.02	6.03	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 610/152x13		6.0	x	1/2	6.00	1.73	7.07	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 610/178x13		7.0	x		7.00	2.02	6.06	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 610/203x13		8.0	x		8.00	2.31	5.30	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 610/152x19		6.0	x	3/4	9.00	1.73	7.15	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 610/203x16		8.0	x	5/8	10.00	2.31	5.33	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 610/203x19		8.0	x	3/4	12.00	2.31	5.36	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 610/254x19		10.0	x		15.00	2.89	4.29	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 610/203x25		8.0	x	1	16.00	2.31	5.41	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 610/254x25		10.0	x		20.00	2.89	4.33	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 610/279x25		11.0	x		22.00	3.18	3.94	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 610/305x25		12.0	x		24.00	3.46	3.61	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 610/254x32		10.0	x	1 1/4	25.00	2.89	4.38	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 610/330x25		13.0	x	1	26.00	3.75	3.33	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 610/356x25		14.0	x		28.00	4.04	3.09	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 610/305x32		12.0	x	1 1/4	30.00	3.46	3.65	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 610/406x25		16.0	x	1	32.00	4.62	2.71	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 610/356x32		14.0	x	1 1/4	35.00	4.04	3.13	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 610/406x32		16.0	x		40.00	4.62	2.73	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 610/450x32		17.7	x		44.29	5.11	2.47	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web	Flange Width		Flange Thickness	Area			Factored Compressive Resistance Vr (kip) Effective length (ft) with respect to least radius of gyration (r_y)													
	h_w (in)	b_f (in)		t_f (in)	(in2)	r_y (in)	r_x/r_y	0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
WT_ 750/127x6	29.5	5.0	x	1/4	2.50	1.44	10.32	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 750/152x6		6.0	x		3.00	1.73	8.60	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 750/152x8		6.0	x	5/16	3.75	1.73	8.61	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 750/152x10		6.0	x	3/8	4.50	1.73	8.63	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 750/178x10		7.0	x		5.25	2.02	7.40	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 750/152x13		6.0	x	1/2	6.00	1.73	8.67	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 750/178x13		7.0	x		7.00	2.02	7.43	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 750/203x13		8.0	x		8.00	2.31	6.50	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 750/152x19		6.0	x	3/4	9.00	1.73	8.74	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 750/203x16		8.0	x	5/8	10.00	2.31	6.53	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 750/203x19		8.0	x	3/4	12.00	2.31	6.56	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 750/254x19		10.0	x		15.00	2.89	5.24	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 750/203x25		8.0	x	1	16.00	2.31	6.61	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 750/254x25		10.0	x		20.00	2.89	5.29	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 750/279x25		11.0	x		22.00	3.18	4.81	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 750/305x25		12.0	x		24.00	3.46	4.41	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 750/254x32		10.0	x	1 1/4	25.00	2.89	5.33	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 750/330x25		13.0	x	1	26.00	3.75	4.07	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 750/356x25		14.0	x		28.00	4.04	3.78	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 750/305x32		12.0	x	1 1/4	30.00	3.46	4.44	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 750/406x25		16.0	x	1	32.00	4.62	3.31	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 750/356x32		14.0	x	1 1/4	35.00	4.04	3.81	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 750/406x32		16.0	x		40.00	4.62	3.33	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 750/450x32		17.7	x		44.29	5.11	3.01	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web	Flange Width		Flange Thickness	Area			Factored Compressive Resistance Vr (kip) Effective length (ft) with respect to least radius of gyration (r_y)													
	h_w (in)	b_f (in)		t_f (in)	(in2)	r_y (in)	r_x/r_y	0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*	*t*	*u*
WT_ 900/127x6	35.4	5.0	x	1/4	2.50	1.44	12.36	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 900/152x6		6.0	x		3.00	1.73	10.30	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 900/152x8		6.0	x	5/16	3.75	1.73	10.32	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 900/152x10		6.0	x	3/8	4.50	1.73	10.34	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 900/178x10		7.0	x		5.25	2.02	8.86	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 900/152x13		6.0	x	1/2	6.00	1.73	10.37	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 900/178x13		7.0	x		7.00	2.02	8.89	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 900/203x13		8.0	x		8.00	2.31	7.78	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 900/152x19		6.0	x	3/4	9.00	1.73	10.45	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 900/203x16		8.0	x	5/8	10.00	2.31	7.81	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 900/203x19		8.0	x	3/4	12.00	2.31	7.83	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 900/254x19		10.0	x		15.00	2.89	6.27	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 900/203x25		8.0	x	1	16.00	2.31	7.89	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 900/254x25		10.0	x		20.00	2.89	6.31	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 900/279x25		11.0	x		22.00	3.18	5.74	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 900/305x25		12.0	x		24.00	3.46	5.26	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 900/254x32		10.0	x	1 1/4	25.00	2.89	6.35	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 900/330x25		13.0	x	1	26.00	3.75	4.85	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 900/356x25		14.0	x		28.00	4.04	4.51	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 900/305x32		12.0	x	1 1/4	30.00	3.46	5.30	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 900/406x25		16.0	x	1	32.00	4.62	3.94	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 900/356x32		14.0	x	1 1/4	35.00	4.04	4.54	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 900/406x32		16.0	x		40.00	4.62	3.97	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 900/450x32		17.7	x		44.29	5.11	3.59	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SINBEAM LIGHTER BY DESIGN

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web	Flange			Area			Factored Compressive Resistance Vr (kip)													
		Width		Thickness				Effective length (ft) with respect to least radius of gyration (r_y)													
	h_w (in)	b_f (in)		t_f (in)	(in2)	r_y (in)	r_x/r_y	0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*	*t*	*u*
WT_ 1000/127x6	39.4	5.0	x	1/4	2.50	1.44	13.72	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 1000/152x6		6.0	x		3.00	1.73	11.44	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 1000/152x8		6.0	x	5/16	3.75	1.73	11.46	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 1000/152x10		6.0	x	3/8	4.50	1.73	11.47	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 1000/178x10		7.0	x		5.25	2.02	9.83	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 1000/152x13		6.0	x	1/2	6.00	1.73	11.51	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 1000/178x13		7.0	x		7.00	2.02	9.87	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 1000/203x13		8.0	x		8.00	2.31	8.63	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 1000/152x19		6.0	x	3/4	9.00	1.73	11.58	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 1000/203x16		8.0	x	5/8	10.00	2.31	8.66	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 1000/203x19		8.0	x	3/4	12.00	2.31	8.69	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 1000/254x19		10.0	x		15.00	2.89	6.95	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 1000/203x25		8.0	x	1	16.00	2.31	8.74	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 1000/254x25		10.0	x		20.00	2.89	6.99	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 1000/279x25		11.0	x		22.00	3.18	6.36	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 1000/305x25		12.0	x		24.00	3.46	5.83	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 1000/254x32		10.0	x	1 1/4	25.00	2.89	7.04	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 1000/330x25		13.0	x	1	26.00	3.75	5.38	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 1000/356x25		14.0	x		28.00	4.04	5.00	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 1000/305x32		12.0	x	1 1/4	30.00	3.46	5.86	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 1000/406x25		16.0	x	1	32.00	4.62	4.37	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 1000/356x32		14.0	x	1 1/4	35.00	4.04	5.03	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 1000/406x32		16.0	x		40.00	4.62	4.40	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 1000/450x32		17.7	x		44.29	5.11	3.97	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Area (in2)	r_y (in)	r_x/r_y	Factored Compressive Resistance Vr (kip) — Effective length (ft) with respect to least radius of gyration (r_y)													
								0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
WT_ 1219/127x6	48.0	5.0	x	1/4	2.50	1.44	16.71	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 1219/152x6		6.0	x		3.00	1.73	13.93	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 1219/152x8		6.0	x	5/16	3.75	1.73	13.95	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 1219/152x10		6.0	x	3/8	4.50	1.73	13.96	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 1219/178x10		7.0	x		5.25	2.02	11.97	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 1219/152x13		6.0	x	1/2	6.00	1.73	14.00	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 1219/178x13		7.0	x		7.00	2.02	12.00	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 1219/203x13		8.0	x		8.00	2.31	10.50	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 1219/152x19		6.0	x	3/4	9.00	1.73	14.07	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 1219/203x16		8.0	x	5/8	10.00	2.31	10.53	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 1219/203x19		8.0	x	3/4	12.00	2.31	10.56	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 1219/254x19		10.0	x		15.00	2.89	8.44	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 1219/203x25		8.0	x	1	16.00	2.31	10.61	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 1219/254x25		10.0	x		20.00	2.89	8.49	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 1219/279x25		11.0	x		22.00	3.18	7.72	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 1219/305x25		12.0	x		24.00	3.46	7.07	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 1219/254x32		10.0	x	1 1/4	25.00	2.89	8.53	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 1219/330x25		13.0	x	1	26.00	3.75	6.53	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 1219/356x25		14.0	x		28.00	4.04	6.06	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 1219/305x32		12.0	x	1 1/4	30.00	3.46	7.11	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 1219/406x25		16.0	x	1	32.00	4.62	5.30	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 1219/356x32		14.0	x	1 1/4	35.00	4.04	6.09	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 1219/406x32		16.0	x		40.00	4.62	5.33	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 1219/450x32		17.7	x		44.29	5.11	4.82	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

SIN Beam Axial Capacity

Imperial

Designation	Depth of Web h_w (in)	Flange Width b_f (in)		Flange Thickness t_f (in)	Area (in2)	r_y (in)	r_x/r_y	Factored Compressive Resistance Vr (kip) — Effective length (ft) with respect to least radius of gyration (r_y): 0	5	10	15	20	25	30	35	40	45	50	55	60	65
size	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*	*t*	*u*
WT_ 1500/127x6	59.1	5.0	x	1/4	2.50	1.44	20.54	114.2	99.4	61.1	34.9	21.4	14.2	10.1	7.5	5.7	4.6	3.7	3.1	2.6	2.2
WT_ 1500/152x6		6.0	x		3.00	1.73	17.12	137.1	125.5	88.2	55.1	35.3	23.9	17.1	12.7	9.8	7.8	6.4	5.3	4.4	3.8
WT_ 1500/152x8		6.0	x	5/16	3.75	1.73	17.14	171.3	156.8	110.2	68.9	44.1	29.9	21.3	15.9	12.3	9.8	8.0	6.6	5.5	4.7
WT_ 1500/152x10		6.0	x	3/8	4.50	1.73	17.16	205.6	188.2	132.3	82.7	52.9	35.8	25.6	19.1	14.8	11.7	9.5	7.9	6.7	5.7
WT_ 1500/178x10		7.0	x		5.25	2.02	14.71	239.9	226.0	174.4	118.2	79.2	54.9	39.7	29.9	23.2	18.5	15.1	12.5	10.5	9.0
WT_ 1500/152x13		6.0	x	1/2	6.00	1.73	17.19	274.1	250.9	176.4	110.3	70.6	47.8	34.1	25.5	19.7	15.6	12.7	10.5	8.9	7.6
WT_ 1500/178x13		7.0	x		7.00	2.02	14.74	319.8	301.3	232.5	157.7	105.6	73.2	53.0	39.8	30.9	24.6	20.1	16.7	14.0	12.0
WT_ 1500/203x13		8.0	x		8.00	2.31	12.89	365.5	350.4	288.5	209.7	147.0	104.7	76.9	58.3	45.5	36.4	29.7	24.7	20.9	17.8
WT_ 1500/152x19		6.0	x	3/4	9.00	1.73	17.26	411.2	376.4	264.6	165.4	105.8	71.7	51.2	38.2	29.5	23.5	19.1	15.8	13.3	11.4
WT_ 1500/203x16		8.0	x	5/8	10.00	2.31	12.92	456.9	438.0	360.7	262.2	183.8	130.8	96.1	72.9	56.9	45.5	37.2	30.9	26.1	22.3
WT_ 1500/203x19		8.0	x	3/4	12.00	2.31	12.95	548.2	525.6	432.8	314.6	220.5	157.0	115.3	87.5	68.3	54.6	44.6	37.1	31.3	26.8
WT_ 1500/254x19		10.0	x		15.00	2.89	10.36	685.3	669.4	596.3	480.9	366.5	275.7	209.5	162.4	128.6	103.8	85.3	71.3	60.3	51.7
WT_ 1500/203x25		8.0	x	1	16.00	2.31	13.00	731.0	700.8	577.1	419.5	294.0	209.3	153.7	116.6	91.0	72.8	59.5	49.5	41.7	35.7
WT_ 1500/254x25		10.0	x		20.00	2.89	10.40	913.7	892.5	795.1	641.2	488.7	367.5	279.4	216.5	171.4	138.4	113.8	95.0	80.4	68.9
WT_ 1500/279x25		11.0	x		22.00	3.18	9.46	1005.1	986.9	900.5	753.8	595.4	460.0	356.2	279.4	223.0	181.1	149.5	125.2	106.2	91.1
WT_ 1500/305x25		12.0	x		24.00	3.46	8.67	1096.5	1080.7	1003.7	865.6	705.5	559.2	441.1	350.5	282.2	230.6	191.1	160.6	136.5	117.4
WT_ 1500/254x32		10.0	x	1 1/4	25.00	2.89	10.45	1142.2	1115.7	993.8	801.5	610.8	459.4	349.2	270.7	214.3	173.0	142.2	118.8	100.6	86.2
WT_ 1500/330x25		13.0	x	1	26.00	3.75	8.00	1187.9	1174.0	1105.2	976.2	817.4	663.5	532.9	429.1	348.8	286.9	238.9	201.4	171.7	147.9
WT_ 1500/356x25		14.0	x		28.00	4.04	7.43	1279.2	1267.0	1205.2	1085.2	930.0	771.5	630.6	514.6	422.3	349.8	292.8	247.8	211.9	182.9
WT_ 1500/305x32		12.0	x	1 1/4	30.00	3.46	8.70	1370.6	1350.9	1254.7	1082.1	881.8	699.0	551.3	438.1	352.8	288.2	238.9	200.7	170.7	146.7
WT_ 1500/406x25		16.0	x	1	32.00	4.62	6.50	1462.0	1452.2	1401.6	1298.4	1154.2	993.7	839.0	702.5	588.1	494.4	418.6	357.3	307.5	266.7
WT_ 1500/356x32		14.0	x	1 1/4	35.00	4.04	7.46	1599.0	1583.7	1506.5	1356.5	1162.5	964.3	788.3	643.2	527.8	437.2	366.0	309.8	264.9	228.6
WT_ 1500/406x32		16.0	x		40.00	4.62	6.53	1827.5	1815.2	1752.0	1623.0	1442.7	1242.1	1048.7	878.2	735.1	618.0	523.3	446.6	384.3	333.4
WT_ 1500/450x32		17.7	x		44.29	5.11	5.90	2023.5	2013.2	1959.2	1845.7	1679.5	1483.6	1283.4	1097.3	934.1	795.8	680.7	585.6	507.1	442.1

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SINBEAM LIGHTER BY DESIGN

SIN Concentrated Load

Factored Resistance

Metric

Constants

Fy	350 MPa
ϕ_s	0.8

Web t_w (mm)	WTA 1.90 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	16.87	43.43	69.99	96.56	123.12	149.68	176.25	202.81	229.37
7.9	21.08	47.65	74.21	100.77	127.34	153.90	180.46	207.03	233.59
9.5	25.30	51.86	78.43	104.99	131.55	158.12	184.68	211.24	237.81
12.7	33.74	60.30	86.86	113.43	139.99	166.55	193.12	219.68	246.24
15.9	42.17	68.73	95.30	121.86	148.42	174.99	201.55	228.11	254.68
19.1	50.60	77.17	103.73	130.29	156.86	183.42	209.98	236.55	263.11
25.4	67.47	94.03	120.60	147.16	173.72	200.29	226.85	253.41	279.98

Web t_w (mm)	WTB 2.66 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	23.62	60.82	98.01	135.21	172.40	209.60	246.79	283.99	321.19
7.9	29.52	66.72	103.92	141.11	178.31	215.50	252.70	289.89	327.09
9.5	35.43	72.62	109.82	147.02	184.21	221.41	258.60	295.80	333.00
12.7	47.24	84.43	121.63	158.83	196.02	233.22	270.41	307.61	344.80
15.9	59.05	96.24	133.44	170.64	207.83	245.03	282.22	319.42	356.61
19.1	70.86	108.05	145.25	182.45	219.64	256.84	294.03	331.23	368.42
25.4	94.48	131.67	168.87	206.06	243.26	280.46	317.65	354.85	392.04

Web t_w (mm)	WTC 3.04 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	27.01	69.54	112.07	154.60	197.13	239.66	282.18	324.71	367.24
7.9	33.76	76.29	118.82	161.35	203.88	246.41	288.94	331.47	374.00
9.5	40.51	83.04	125.57	168.10	210.63	253.16	295.69	338.22	380.75
12.7	54.01	96.54	139.07	181.60	224.13	266.66	309.19	351.72	394.25
15.9	67.52	110.05	152.58	195.11	237.64	280.16	322.69	365.22	407.75
19.1	81.02	123.55	166.08	208.61	251.14	293.67	336.20	378.73	421.26
25.4	108.03	150.56	193.09	235.61	278.14	320.67	363.20	405.73	448.26

SIN Concentrated Load

Factored Resistance

Metric

Constants

Fy	350	MPa
ϕ_s	0.8	

Web t_w (mm)	WTF 4.18 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	37.12	95.58	154.04	212.50	270.97	329.43	387.89	446.35	504.81
7.9	46.40	104.86	163.32	221.79	280.25	338.71	397.17	455.63	514.09
9.5	55.68	114.14	172.61	231.07	289.53	347.99	406.45	464.91	523.37
12.7	74.25	132.71	191.17	249.63	308.09	366.55	425.01	483.47	541.93
15.9	92.81	151.27	209.73	268.19	326.65	385.11	443.57	502.03	560.49
19.1	111.37	169.83	228.29	286.75	345.21	403.67	462.13	520.59	579.05
25.4	148.49	206.95	265.41	323.87	382.33	440.79	499.25	557.71	616.18

Web t_w (mm)	WTH 4.94 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	43.87	112.97	182.06	251.15	320.25	389.34	458.43	527.53	596.62
7.9	54.84	123.94	193.03	262.12	331.21	400.31	469.40	538.49	607.59
9.5	65.81	134.90	204.00	273.09	342.18	411.28	480.37	549.46	618.56
12.7	87.75	156.84	225.93	295.03	364.12	433.21	502.31	571.40	640.49
15.9	109.69	178.78	247.87	316.96	386.06	455.15	524.24	593.34	662.43
19.1	131.62	200.72	269.81	338.90	407.99	477.09	546.18	615.27	684.37
25.4	175.50	244.59	313.68	382.78	451.87	520.96	590.05	659.15	728.24

Web t_w (mm)	WTK 6.07 Bearing Length (mm)								
t_f (mm)	0	50	100	150	200	250	300	350	400
6.4	53.99	139.01	224.04	309.06	394.09	479.11	564.13	649.16	734.18
7.9	67.49	152.51	237.54	322.56	407.58	492.61	577.63	662.66	747.68
9.5	80.99	166.01	251.03	336.06	421.08	506.11	591.13	676.15	761.18
12.7	107.98	193.00	278.03	363.05	448.08	533.10	618.12	703.15	788.17
15.9	134.98	220.00	305.02	390.05	475.07	560.10	645.12	730.14	815.17
19.1	161.97	246.99	332.02	417.04	502.07	587.09	672.11	757.14	842.16
25.4	215.96	300.98	386.01	471.03	556.06	641.08	726.10	811.13	896.15

SINBEAM LIGHTER BY DESIGN

SIN Concentrated Load

Factored Resistance

Imperial

Constants

Fy	50.8	ksi
ϕ_s	0.8	

Web t_w (in)	WTA 0.0747 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	3.79	9.86	15.93	21.99	28.06	34.13	40.20	46.26	52.33
5/16	4.74	10.81	16.87	22.94	29.01	35.08	41.14	47.21	53.28
3/8	5.69	11.76	17.82	23.89	29.96	36.02	42.09	48.16	54.23
1/2	7.58	13.65	19.72	25.79	31.85	37.92	43.99	50.05	56.12
5/8	9.48	15.55	21.61	27.68	33.75	39.82	45.88	51.95	58.02
3/4	11.38	17.44	23.51	29.58	35.64	41.71	47.78	53.85	59.91
1	15.17	21.24	27.30	33.37	39.44	45.50	51.57	57.64	63.71

Web t_w (in)	WTB 0.1046 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	5.31	13.81	22.30	30.80	39.29	47.79	56.28	64.78	73.28
5/16	6.64	15.13	23.63	32.12	40.62	49.12	57.61	66.11	74.60
3/8	7.96	16.46	24.96	33.45	41.95	50.44	58.94	67.43	75.93
1/2	10.62	19.12	27.61	36.11	44.60	53.10	61.59	70.09	78.59
5/8	13.27	21.77	30.27	38.76	47.26	55.75	64.25	72.74	81.24
3/4	15.93	24.43	32.92	41.42	49.91	58.41	66.90	75.40	83.90
1	21.24	29.74	38.23	46.73	55.22	63.72	72.21	80.71	89.21

Web t_w (in)	WTC 0.1196 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	6.07	15.79	25.50	35.21	44.93	54.64	64.36	74.07	83.78
5/16	7.59	17.30	27.02	36.73	46.45	56.16	65.87	75.59	85.30
3/8	9.11	18.82	28.54	38.25	47.96	57.68	67.39	77.11	86.82
1/2	12.14	21.86	31.57	41.28	51.00	60.71	70.43	80.14	89.85
5/8	15.18	24.89	34.61	44.32	54.03	63.75	73.46	83.18	92.89
3/4	18.21	27.93	37.64	47.36	57.07	66.78	76.50	86.21	95.93
1	24.29	34.00	43.71	53.43	63.14	72.86	82.57	92.28	102.00

SINBEAM LIGHTER BY DESIGN

SIN Concentrated Load

Factored Resistance

Imperial

Constants

Fy	50.8 ksi
ϕ_s	0.8

Web t_w (in)	WTF 0.1644 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	8.35	21.70	35.05	48.40	61.76	75.11	88.46	101.81	115.17
5/16	10.43	23.78	37.14	50.49	63.84	77.20	90.55	103.90	117.25
3/8	12.52	25.87	39.22	52.58	65.93	79.28	92.63	105.99	119.34
1/2	16.69	30.04	43.40	56.75	70.10	83.45	96.81	110.16	123.51
5/8	20.86	34.22	47.57	60.92	74.27	87.63	100.98	114.33	127.69
3/4	25.04	38.39	51.74	65.09	78.45	91.80	105.15	118.51	131.86
1	33.38	46.73	60.09	73.44	86.79	100.15	113.50	126.85	140.20

Web t_w (in)	WTH 0.1943 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	9.86	25.64	41.43	57.21	72.99	88.77	104.55	120.33	136.11
5/16	12.33	28.11	43.89	59.67	75.45	91.24	107.02	122.80	138.58
3/8	14.79	30.58	46.36	62.14	77.92	93.70	109.48	125.26	141.05
1/2	19.73	35.51	51.29	67.07	82.85	98.63	114.41	130.20	145.98
5/8	24.66	40.44	56.22	72.00	87.78	103.56	119.35	135.13	150.91
3/4	29.59	45.37	61.15	76.93	92.71	108.50	124.28	140.06	155.84
1	39.45	55.23	71.02	86.80	102.58	118.36	134.14	149.92	165.70

Web t_w (in)	WTK 0.2391 Bearing Length (in)								
t_f (mm)	0	2	4	6	8	10	12	14	16
1/4	12.14	31.56	50.98	70.40	89.82	109.24	128.66	148.08	167.50
5/16	15.17	34.59	54.01	73.43	92.85	112.27	131.69	151.11	170.53
3/8	18.21	37.63	57.05	76.47	95.89	115.31	134.73	154.15	173.57
1/2	24.27	43.69	63.11	82.53	101.95	121.37	140.79	160.21	179.63
5/8	30.34	49.76	69.18	88.60	108.02	127.44	146.86	166.28	185.70
3/4	36.41	55.83	75.25	94.67	114.09	133.51	152.93	172.35	191.77
1	48.55	67.97	87.39	106.81	126.23	145.65	165.07	184.49	203.91

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = $3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}$

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m²) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 333/127x6	1.18	1.18	1.18	1.18	1.18	1.17	15.6	17.6	18.6	21.6	23.6	26.6	0.27	0.30	0.32	0.37	0.40	0.45
WT_ 333/152x6	1.26	1.26	1.26	1.25	1.25	1.25	16.7	18.6	19.5	22.3	24.2	27.0	0.28	0.32	0.33	0.38	0.41	0.46
WT_ 333/152x8	1.26	1.26	1.26	1.26	1.26	1.26	19.6	21.5	22.4	25.2	27.1	29.9	0.33	0.37	0.38	0.43	0.46	0.51
WT_ 333/152x10	1.27	1.27	1.27	1.27	1.26	1.26	22.5	24.4	25.3	28.1	30.0	32.8	0.38	0.42	0.43	0.48	0.51	0.56
WT_ 333/178x10	1.35	1.34	1.34	1.34	1.34	1.34	24.1	25.8	26.7	29.3	31.1	33.7	0.41	0.44	0.45	0.50	0.53	0.57
WT_ 333/152x13	1.28	1.28	1.28	1.28	1.28	1.27	28.2	30.1	31.0	33.8	35.6	38.4	0.48	0.51	0.53	0.57	0.61	0.65
WT_ 333/178x13	1.36	1.36	1.36	1.35	1.35	1.35	30.4	32.1	33.0	35.6	37.4	40.0	0.52	0.55	0.56	0.61	0.64	0.68
WT_ 333/203x13	1.44	1.43	1.43	1.43	1.43	1.43	32.3	33.9	34.8	37.2	38.9	41.4	0.55	0.58	0.59	0.63	0.66	0.71
WT_ 333/152x19	1.31	1.31	1.31	1.30	1.30	1.30	39.3	41.1	42.0	44.8	46.6	49.3	0.67	0.70	0.72	0.76	0.79	0.84
WT_ 333/203x16	1.45	1.45	1.45	1.44	1.44	1.44	39.0	40.6	41.5	43.9	45.6	48.1	0.66	0.69	0.71	0.75	0.78	0.82
WT_ 333/203x19	1.46	1.46	1.46	1.46	1.45	1.45	45.6	47.2	48.0	50.5	52.2	54.6	0.78	0.80	0.82	0.86	0.89	0.93
WT_ 333/254x19	1.61	1.61	1.61	1.61	1.61	1.60	50.7	52.2	52.9	55.2	56.7	58.9	0.86	0.89	0.90	0.94	0.97	1.00
WT_ 333/203x25	1.49	1.48	1.48	1.48	1.48	1.48	58.4	60.1	60.9	63.3	64.9	67.4	1.00	1.02	1.04	1.08	1.11	1.15
WT_ 333/254x25	1.64	1.64	1.64	1.63	1.63	1.63	65.4	66.8	67.6	69.8	71.3	73.5	1.11	1.14	1.15	1.19	1.21	1.25
WT_ 333/279x25	1.71	1.71	1.71	1.71	1.71	1.71	68.4	69.8	70.5	72.6	74.0	76.2	1.16	1.19	1.20	1.24	1.26	1.30
WT_ 333/305x25	1.79	1.79	1.79	1.79	1.78	1.78	71.1	72.5	73.2	75.2	76.6	78.6	1.21	1.23	1.25	1.28	1.30	1.34
WT_ 333/254x32	1.66	1.66	1.66	1.66	1.66	1.66	79.6	81.1	81.8	84.0	85.5	87.7	1.36	1.38	1.39	1.43	1.46	1.49
WT_ 333/330x25	1.87	1.87	1.86	1.86	1.86	1.86	73.6	74.9	75.6	77.6	78.9	80.8	1.25	1.28	1.29	1.32	1.34	1.38
WT_ 333/356x25	1.94	1.94	1.94	1.94	1.94	1.93	76.0	77.2	77.8	79.7	81.0	82.9	1.29	1.32	1.33	1.36	1.38	1.41
WT_ 333/305x32	1.82	1.81	1.81	1.81	1.81	1.81	86.8	88.2	88.9	90.9	92.3	94.3	1.48	1.50	1.51	1.55	1.57	1.61
WT_ 333/406x25	2.10	2.09	2.09	2.09	2.09	2.09	80.1	81.3	81.9	83.6	84.8	86.5	1.36	1.38	1.39	1.42	1.44	1.47
WT_ 333/356x32	1.97	1.97	1.97	1.96	1.96	1.96	93.0	94.2	94.9	96.8	98.0	99.9	1.58	1.61	1.62	1.65	1.67	1.70
WT_ 333/406x32	2.12	2.12	2.12	2.12	2.11	2.11	98.2	99.4	100.0	101.7	102.9	104.7	1.67	1.69	1.70	1.73	1.75	1.78
WT_ 333/450x32	2.25	2.25	2.25	2.25	2.25	2.24	102.2	103.3	103.8	105.5	106.6	108.3	1.74	1.76	1.77	1.80	1.82	1.84

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m^2) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 440/127x6	1.43	1.43	1.43	1.43	1.43	1.42	14.2	16.4	17.4	20.7	22.9	26.1	0.24	0.28	0.30	0.35	0.39	0.45
WT_ 440/152x6	1.51	1.51	1.51	1.50	1.50	1.50	15.2	17.2	18.2	21.3	23.4	26.5	0.26	0.29	0.31	0.36	0.40	0.45
WT_ 440/152x8	1.51	1.51	1.51	1.51	1.51	1.51	17.6	19.7	20.7	23.8	25.8	28.9	0.30	0.33	0.35	0.40	0.44	0.49
WT_ 440/152x10	1.52	1.52	1.52	1.52	1.51	1.51	20.0	22.1	23.1	26.2	28.2	31.3	0.34	0.38	0.39	0.45	0.48	0.53
WT_ 440/178x10	1.60	1.59	1.59	1.59	1.59	1.59	21.5	23.4	24.4	27.3	29.2	32.2	0.37	0.40	0.42	0.46	0.50	0.55
WT_ 440/152x13	1.53	1.53	1.53	1.53	1.53	1.52	24.8	26.8	27.9	30.9	33.0	36.0	0.42	0.46	0.47	0.53	0.56	0.61
WT_ 440/178x13	1.61	1.61	1.61	1.60	1.60	1.60	26.8	28.7	29.7	32.6	34.5	37.5	0.46	0.49	0.51	0.56	0.59	0.64
WT_ 440/203x13	1.69	1.68	1.68	1.68	1.68	1.68	28.6	30.4	31.4	34.1	36.0	38.8	0.49	0.52	0.53	0.58	0.61	0.66
WT_ 440/152x19	1.56	1.56	1.56	1.55	1.55	1.55	34.2	36.2	37.2	40.2	42.2	45.2	0.58	0.62	0.63	0.68	0.72	0.77
WT_ 440/203x16	1.70	1.70	1.70	1.69	1.69	1.69	34.3	36.2	37.1	39.9	41.7	44.5	0.58	0.62	0.63	0.68	0.71	0.76
WT_ 440/203x19	1.71	1.71	1.71	1.71	1.70	1.70	40.0	41.8	42.8	45.5	47.3	50.1	0.68	0.71	0.73	0.78	0.81	0.85
WT_ 440/254x19	1.86	1.86	1.86	1.86	1.86	1.85	44.9	46.6	47.4	49.9	51.6	54.2	0.76	0.79	0.81	0.85	0.88	0.92
WT_ 440/203x25	1.74	1.73	1.73	1.73	1.73	1.73	51.1	52.9	53.8	56.5	58.4	61.1	0.87	0.90	0.92	0.96	0.99	1.04
WT_ 440/254x25	1.89	1.89	1.89	1.88	1.88	1.88	57.7	59.4	60.2	62.7	64.4	66.9	0.98	1.01	1.03	1.07	1.10	1.14
WT_ 440/279x25	1.96	1.96	1.96	1.96	1.96	1.96	60.6	62.2	63.0	65.4	67.1	69.5	1.03	1.06	1.07	1.11	1.14	1.18
WT_ 440/305x25	2.04	2.04	2.04	2.04	2.03	2.03	63.3	64.9	65.6	68.0	69.5	71.9	1.08	1.10	1.12	1.16	1.18	1.22
WT_ 440/254x32	1.91	1.91	1.91	1.91	1.91	1.91	70.2	71.8	72.6	75.1	76.8	79.3	1.19	1.22	1.24	1.28	1.31	1.35
WT_ 440/330x25	2.12	2.12	2.11	2.11	2.11	2.11	65.8	67.3	68.1	70.3	71.8	74.1	1.12	1.15	1.16	1.20	1.22	1.26
WT_ 440/356x25	2.19	2.19	2.19	2.19	2.19	2.18	68.1	69.6	70.3	72.5	73.9	76.1	1.16	1.19	1.20	1.23	1.26	1.30
WT_ 440/305x32	2.07	2.06	2.06	2.06	2.06	2.06	77.2	78.8	79.6	81.9	83.4	85.7	1.32	1.34	1.35	1.39	1.42	1.46
WT_ 440/406x25	2.35	2.34	2.34	2.34	2.34	2.34	72.4	73.7	74.4	76.4	77.8	79.8	1.23	1.26	1.27	1.30	1.32	1.36
WT_ 440/356x32	2.22	2.22	2.22	2.21	2.21	2.21	83.3	84.8	85.5	87.7	89.1	91.3	1.42	1.44	1.46	1.49	1.52	1.55
WT_ 440/406x32	2.37	2.37	2.37	2.37	2.37	2.36	88.7	90.0	90.7	92.7	94.1	96.1	1.51	1.53	1.54	1.58	1.60	1.64
WT_ 440/450x32	2.50	2.50	2.50	2.50	2.50	2.49	92.7	94.0	94.6	96.6	97.9	99.8	1.58	1.60	1.61	1.64	1.67	1.70

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m^2) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 500/127x6	1.57	1.57	1.57	1.57	1.57	1.56	13.6	15.8	16.9	20.3	22.6	25.9	0.23	0.27	0.29	0.35	0.38	0.44
WT_ 500/152x6	1.65	1.65	1.65	1.64	1.64	1.64	14.5	16.6	17.7	20.9	23.0	26.3	0.25	0.28	0.30	0.36	0.39	0.45
WT_ 500/152x8	1.65	1.65	1.65	1.65	1.65	1.65	16.7	18.9	19.9	23.1	25.3	28.5	0.29	0.32	0.34	0.39	0.43	0.48
WT_ 500/152x10	1.66	1.66	1.66	1.66	1.65	1.65	19.0	21.1	22.1	25.3	27.5	30.7	0.32	0.36	0.38	0.43	0.47	0.52
WT_ 500/178x10	1.74	1.74	1.73	1.73	1.73	1.73	20.3	22.3	23.4	26.4	28.4	31.5	0.35	0.38	0.40	0.45	0.48	0.54
WT_ 500/152x13	1.67	1.67	1.67	1.67	1.67	1.66	23.4	25.5	26.5	29.7	31.8	35.0	0.40	0.43	0.45	0.51	0.54	0.60
WT_ 500/178x13	1.75	1.75	1.75	1.74	1.74	1.74	25.2	27.3	28.3	31.3	33.3	36.4	0.43	0.46	0.48	0.53	0.57	0.62
WT_ 500/203x13	1.83	1.82	1.82	1.82	1.82	1.82	27.0	28.9	29.9	32.8	34.7	37.6	0.46	0.49	0.51	0.56	0.59	0.64
WT_ 500/152x19	1.70	1.70	1.70	1.69	1.69	1.69	32.0	34.0	35.1	38.2	40.3	43.5	0.54	0.58	0.60	0.65	0.69	0.74
WT_ 500/203x16	1.84	1.84	1.84	1.83	1.83	1.83	32.3	34.2	35.2	38.1	40.0	42.9	0.55	0.58	0.60	0.65	0.68	0.73
WT_ 500/203x19	1.85	1.85	1.85	1.85	1.84	1.84	37.5	39.5	40.4	43.3	45.2	48.1	0.64	0.67	0.69	0.74	0.77	0.82
WT_ 500/254x19	2.00	2.00	2.00	2.00	2.00	2.00	42.3	44.0	44.9	47.6	49.4	52.0	0.72	0.75	0.77	0.81	0.84	0.89
WT_ 500/203x25	1.88	1.87	1.87	1.87	1.87	1.87	47.8	49.7	50.7	53.5	55.4	58.3	0.81	0.85	0.86	0.91	0.94	0.99
WT_ 500/254x25	2.03	2.03	2.03	2.02	2.02	2.02	54.2	56.0	56.9	59.5	61.3	63.9	0.92	0.95	0.97	1.01	1.04	1.09
WT_ 500/279x25	2.11	2.10	2.10	2.10	2.10	2.10	57.1	58.8	59.6	62.2	63.9	66.4	0.97	1.00	1.02	1.06	1.09	1.13
WT_ 500/305x25	2.18	2.18	2.18	2.18	2.18	2.17	59.7	61.4	62.2	64.6	66.3	68.8	1.02	1.05	1.06	1.10	1.13	1.17
WT_ 500/254x32	2.05	2.05	2.05	2.05	2.05	2.05	65.9	67.6	68.5	71.1	72.9	75.5	1.12	1.15	1.17	1.21	1.24	1.29
WT_ 500/330x25	2.26	2.26	2.26	2.25	2.25	2.25	62.2	63.8	64.6	67.0	68.5	70.9	1.06	1.09	1.10	1.14	1.17	1.21
WT_ 500/356x25	2.33	2.33	2.33	2.33	2.33	2.33	64.5	66.0	66.8	69.1	70.7	73.0	1.10	1.12	1.14	1.18	1.20	1.24
WT_ 500/305x32	2.21	2.21	2.20	2.20	2.20	2.20	72.8	74.4	75.2	77.7	79.3	81.8	1.24	1.27	1.28	1.32	1.35	1.39
WT_ 500/406x25	2.49	2.48	2.48	2.48	2.48	2.48	68.7	70.1	70.9	73.0	74.5	76.7	1.17	1.19	1.21	1.24	1.27	1.31
WT_ 500/356x32	2.36	2.36	2.36	2.35	2.35	2.35	78.8	80.4	81.1	83.4	85.0	87.3	1.34	1.37	1.38	1.42	1.45	1.49
WT_ 500/406x32	2.51	2.51	2.51	2.51	2.51	2.50	84.1	85.6	86.3	88.5	89.9	92.1	1.43	1.46	1.47	1.51	1.53	1.57
WT_ 500/450x32	2.64	2.64	2.64	2.64	2.64	2.63	88.2	89.6	90.2	92.3	93.7	95.7	1.50	1.53	1.54	1.57	1.60	1.63

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

$\text{Surf Area} = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}$

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m²) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 610/127x6	1.83	1.83	1.83	1.82	1.82	1.82	12.7	15.1	16.2	19.8	22.1	25.6	0.22	0.26	0.28	0.34	0.38	0.44
WT_ 610/152x6	1.90	1.90	1.90	1.90	1.90	1.90	13.6	15.8	16.9	20.3	22.6	25.9	0.23	0.27	0.29	0.35	0.38	0.44
WT_ 610/152x8	1.91	1.91	1.91	1.91	1.90	1.90	15.5	17.7	18.9	22.2	24.5	27.8	0.26	0.30	0.32	0.38	0.42	0.47
WT_ 610/152x10	1.92	1.92	1.91	1.91	1.91	1.91	17.4	19.7	20.8	24.1	26.4	29.7	0.30	0.33	0.35	0.41	0.45	0.51
WT_ 610/178x10	1.99	1.99	1.99	1.99	1.99	1.98	18.7	20.8	21.9	25.1	27.3	30.5	0.32	0.35	0.37	0.43	0.46	0.52
WT_ 610/152x13	1.93	1.93	1.93	1.92	1.92	1.92	21.3	23.5	24.6	27.9	30.2	33.5	0.36	0.40	0.42	0.48	0.51	0.57
WT_ 610/178x13	2.01	2.00	2.00	2.00	2.00	2.00	23.0	25.1	26.2	29.4	31.5	34.8	0.39	0.43	0.45	0.50	0.54	0.59
WT_ 610/203x13	2.08	2.08	2.08	2.08	2.08	2.07	24.6	26.6	27.7	30.7	32.8	35.9	0.42	0.45	0.47	0.52	0.56	0.61
WT_ 610/152x19	1.95	1.95	1.95	1.95	1.95	1.95	28.7	30.9	32.0	35.3	37.6	40.9	0.49	0.53	0.55	0.60	0.64	0.70
WT_ 610/203x16	2.09	2.09	2.09	2.09	2.09	2.09	29.2	31.3	32.3	35.4	37.5	40.6	0.50	0.53	0.55	0.60	0.64	0.69
WT_ 610/203x19	2.11	2.11	2.10	2.10	2.10	2.10	33.9	35.9	36.9	40.0	42.1	45.1	0.58	0.61	0.63	0.68	0.72	0.77
WT_ 610/254x19	2.26	2.26	2.26	2.26	2.25	2.25	38.3	40.2	41.2	44.0	46.0	48.8	0.65	0.69	0.70	0.75	0.78	0.83
WT_ 610/203x25	2.13	2.13	2.13	2.13	2.13	2.12	43.0	45.0	46.0	49.1	51.1	54.1	0.73	0.77	0.78	0.84	0.87	0.92
WT_ 610/254x25	2.29	2.28	2.28	2.28	2.28	2.28	49.0	50.9	51.8	54.7	56.6	59.4	0.83	0.87	0.88	0.93	0.96	1.01
WT_ 610/279x25	2.36	2.36	2.36	2.36	2.36	2.35	51.7	53.5	54.4	57.2	59.0	61.8	0.88	0.91	0.93	0.97	1.01	1.05
WT_ 610/305x25	2.44	2.44	2.44	2.43	2.43	2.43	54.2	56.0	56.9	59.6	61.3	64.0	0.92	0.95	0.97	1.01	1.04	1.09
WT_ 610/254x32	2.31	2.31	2.31	2.31	2.30	2.30	59.4	61.3	62.2	65.0	66.9	69.8	1.01	1.04	1.06	1.11	1.14	1.19
WT_ 610/330x25	2.51	2.51	2.51	2.51	2.51	2.51	56.6	58.3	59.2	61.8	63.5	66.1	0.96	0.99	1.01	1.05	1.08	1.13
WT_ 610/356x25	2.59	2.59	2.59	2.59	2.58	2.58	58.9	60.5	61.4	63.9	65.6	68.1	1.00	1.03	1.05	1.09	1.12	1.16
WT_ 610/305x32	2.46	2.46	2.46	2.46	2.46	2.45	66.0	67.8	68.7	71.3	73.1	75.7	1.12	1.15	1.17	1.21	1.24	1.29
WT_ 610/406x25	2.74	2.74	2.74	2.74	2.74	2.73	63.0	64.6	65.4	67.7	69.3	71.7	1.07	1.10	1.11	1.15	1.18	1.22
WT_ 610/356x32	2.62	2.61	2.61	2.61	2.61	2.61	71.8	73.5	74.3	76.8	78.5	81.0	1.22	1.25	1.27	1.31	1.34	1.38
WT_ 610/406x32	2.77	2.77	2.77	2.76	2.76	2.76	77.0	78.6	79.4	81.8	83.4	85.7	1.31	1.34	1.35	1.39	1.42	1.46
WT_ 610/450x32	2.90	2.90	2.90	2.89	2.89	2.89	81.1	82.6	83.3	85.6	87.1	89.4	1.38	1.41	1.42	1.46	1.48	1.52

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = $3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}$

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m²) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 750/127x6	2.16	2.15	2.15	2.15	2.15	2.15	11.9	14.4	15.6	19.2	21.7	25.4	0.20	0.24	0.27	0.33	0.37	0.43
WT_ 750/152x6	2.23	2.23	2.23	2.23	2.23	2.22	12.7	15.0	16.2	19.7	22.1	25.6	0.22	0.26	0.28	0.34	0.38	0.44
WT_ 750/152x8	2.24	2.24	2.24	2.23	2.23	2.23	14.3	16.7	17.8	21.4	23.7	27.3	0.24	0.28	0.30	0.36	0.40	0.46
WT_ 750/152x10	2.25	2.24	2.24	2.24	2.24	2.24	16.0	18.3	19.5	23.0	25.4	28.9	0.27	0.31	0.33	0.39	0.43	0.49
WT_ 750/178x10	2.32	2.32	2.32	2.32	2.32	2.31	17.1	19.3	20.5	23.9	26.2	29.6	0.29	0.33	0.35	0.41	0.45	0.50
WT_ 750/152x13	2.26	2.26	2.26	2.25	2.25	2.25	19.2	21.6	22.7	26.2	28.6	32.1	0.33	0.37	0.39	0.45	0.49	0.55
WT_ 750/178x13	2.33	2.33	2.33	2.33	2.33	2.33	20.8	23.0	24.2	27.6	29.8	33.2	0.35	0.39	0.41	0.47	0.51	0.57
WT_ 750/203x13	2.41	2.41	2.41	2.41	2.40	2.40	22.2	24.4	25.5	28.8	31.0	34.3	0.38	0.42	0.43	0.49	0.53	0.58
WT_ 750/152x19	2.28	2.28	2.28	2.28	2.28	2.27	25.7	28.0	29.2	32.6	34.9	38.4	0.44	0.48	0.50	0.56	0.60	0.65
WT_ 750/203x16	2.42	2.42	2.42	2.42	2.42	2.41	26.3	28.5	29.6	32.8	35.0	38.3	0.45	0.48	0.50	0.56	0.60	0.65
WT_ 750/203x19	2.44	2.43	2.43	2.43	2.43	2.43	30.3	32.5	33.6	36.8	39.0	42.3	0.52	0.55	0.57	0.63	0.66	0.72
WT_ 750/254x19	2.59	2.59	2.59	2.58	2.58	2.58	34.4	36.4	37.5	40.5	42.6	45.7	0.59	0.62	0.64	0.69	0.73	0.78
WT_ 750/203x25	2.46	2.46	2.46	2.46	2.45	2.45	38.2	40.4	41.5	44.7	46.8	50.1	0.65	0.69	0.71	0.76	0.80	0.85
WT_ 750/254x25	2.61	2.61	2.61	2.61	2.61	2.60	43.8	45.8	46.8	49.8	51.9	54.9	0.75	0.78	0.80	0.85	0.88	0.94
WT_ 750/279x25	2.69	2.69	2.69	2.68	2.68	2.68	46.3	48.3	49.2	52.2	54.2	57.1	0.79	0.82	0.84	0.89	0.92	0.97
WT_ 750/305x25	2.77	2.76	2.76	2.76	2.76	2.76	48.7	50.6	51.6	54.4	56.4	59.2	0.83	0.86	0.88	0.93	0.96	1.01
WT_ 750/254x32	2.64	2.64	2.64	2.63	2.63	2.63	52.9	54.9	56.0	59.0	61.0	64.0	0.90	0.94	0.95	1.00	1.04	1.09
WT_ 750/330x25	2.84	2.84	2.84	2.84	2.84	2.83	50.9	52.8	53.7	56.5	58.4	61.2	0.87	0.90	0.92	0.96	0.99	1.04
WT_ 750/356x25	2.92	2.92	2.92	2.91	2.91	2.91	53.1	54.9	55.8	58.5	60.4	63.1	0.90	0.93	0.95	1.00	1.03	1.07
WT_ 750/305x32	2.79	2.79	2.79	2.79	2.79	2.78	59.1	61.0	62.0	64.8	66.8	69.6	1.01	1.04	1.06	1.10	1.14	1.19
WT_ 750/406x25	3.07	3.07	3.07	3.07	3.06	3.06	57.0	58.8	59.6	62.2	64.0	66.6	0.97	1.00	1.02	1.06	1.09	1.13
WT_ 750/356x32	2.94	2.94	2.94	2.94	2.94	2.94	64.7	66.5	67.4	70.1	71.9	74.6	1.10	1.13	1.15	1.19	1.22	1.27
WT_ 750/406x32	3.10	3.09	3.09	3.09	3.09	3.09	69.7	71.4	72.2	74.8	76.6	79.1	1.19	1.22	1.23	1.27	1.30	1.35
WT_ 750/450x32	3.23	3.23	3.22	3.22	3.22	3.22	73.6	75.2	76.1	78.5	80.2	82.7	1.25	1.28	1.30	1.34	1.37	1.41

Steelcon

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in
Highlight M/D < 23.00 kg/m / m

Surf Area = $3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}$
The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m^2) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 900/127x6	2.51	2.51	2.50	2.50	2.50	2.50	11.3	13.8	15.1	18.8	21.4	25.1	0.19	0.24	0.26	0.32	0.36	0.43
WT_ 900/152x6	2.58	2.58	2.58	2.58	2.58	2.57	11.9	14.4	15.6	19.3	21.7	25.4	0.20	0.25	0.27	0.33	0.37	0.43
WT_ 900/152x8	2.59	2.59	2.59	2.58	2.58	2.58	13.4	15.8	17.0	20.7	23.1	26.8	0.23	0.27	0.29	0.35	0.39	0.46
WT_ 900/152x10	2.60	2.59	2.59	2.59	2.59	2.59	14.8	17.2	18.5	22.1	24.5	28.2	0.25	0.29	0.31	0.38	0.42	0.48
WT_ 900/178x10	2.67	2.67	2.67	2.67	2.67	2.66	15.8	18.2	19.4	22.9	25.3	28.8	0.27	0.31	0.33	0.39	0.43	0.49
WT_ 900/152x13	2.61	2.61	2.61	2.60	2.60	2.60	17.7	20.1	21.3	24.9	27.3	31.0	0.30	0.34	0.36	0.42	0.47	0.53
WT_ 900/178x13	2.68	2.68	2.68	2.68	2.68	2.68	19.0	21.4	22.6	26.1	28.5	32.0	0.32	0.36	0.38	0.44	0.48	0.54
WT_ 900/203x13	2.76	2.76	2.76	2.76	2.75	2.75	20.4	22.6	23.8	27.2	29.5	32.9	0.35	0.39	0.41	0.46	0.50	0.56
WT_ 900/152x19	2.63	2.63	2.63	2.63	2.63	2.63	23.3	25.7	26.9	30.5	32.9	36.5	0.40	0.44	0.46	0.52	0.56	0.62
WT_ 900/203x16	2.77	2.77	2.77	2.77	2.77	2.77	23.9	26.2	27.3	30.7	33.0	36.5	0.41	0.45	0.47	0.52	0.56	0.62
WT_ 900/203x19	2.79	2.78	2.78	2.78	2.78	2.78	27.4	29.7	30.8	34.2	36.5	39.9	0.47	0.51	0.53	0.58	0.62	0.68
WT_ 900/254x19	2.94	2.94	2.94	2.93	2.93	2.93	31.2	33.3	34.4	37.6	39.8	43.0	0.53	0.57	0.59	0.64	0.68	0.73
WT_ 900/203x25	2.81	2.81	2.81	2.81	2.81	2.80	34.4	36.6	37.8	41.2	43.4	46.8	0.59	0.62	0.64	0.70	0.74	0.80
WT_ 900/254x25	2.96	2.96	2.96	2.96	2.96	2.96	39.5	41.6	42.7	45.9	48.0	51.2	0.67	0.71	0.73	0.78	0.82	0.87
WT_ 900/279x25	3.04	3.04	3.04	3.04	3.03	3.03	41.8	43.9	44.9	48.1	50.2	53.3	0.71	0.75	0.77	0.82	0.85	0.91
WT_ 900/305x25	3.12	3.11	3.11	3.11	3.11	3.11	44.0	46.1	47.1	50.1	52.2	55.2	0.75	0.78	0.80	0.85	0.89	0.94
WT_ 900/254x32	2.99	2.99	2.99	2.98	2.98	2.98	47.6	49.7	50.8	54.0	56.1	59.3	0.81	0.85	0.86	0.92	0.96	1.01
WT_ 900/330x25	3.19	3.19	3.19	3.19	3.19	3.18	46.2	48.1	49.1	52.1	54.1	57.1	0.79	0.82	0.84	0.89	0.92	0.97
WT_ 900/356x25	3.27	3.27	3.27	3.26	3.26	3.26	48.2	50.1	51.1	54.0	56.0	58.9	0.82	0.85	0.87	0.92	0.95	1.00
WT_ 900/305x32	3.14	3.14	3.14	3.14	3.14	3.13	53.3	55.4	56.4	59.4	61.5	64.5	0.91	0.94	0.96	1.01	1.05	1.10
WT_ 900/406x25	3.42	3.42	3.42	3.42	3.42	3.41	52.0	53.8	54.7	57.5	59.4	62.2	0.88	0.92	0.93	0.98	1.01	1.06
WT_ 900/356x32	3.29	3.29	3.29	3.29	3.29	3.29	58.6	60.5	61.5	64.4	66.3	69.2	1.00	1.03	1.05	1.10	1.13	1.18
WT_ 900/406x32	3.45	3.45	3.44	3.44	3.44	3.44	63.3	65.2	66.1	68.9	70.7	73.5	1.08	1.11	1.13	1.17	1.20	1.25
WT_ 900/450x32	3.58	3.58	3.58	3.57	3.57	3.57	67.1	68.9	69.8	72.4	74.2	76.9	1.14	1.17	1.19	1.23	1.26	1.31

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m²) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_1000/127x6	2.74	2.74	2.74	2.74	2.73	2.73	11.0	13.5	14.8	18.6	21.2	25.0	0.19	0.23	0.25	0.32	0.36	0.43
WT_1000/152x6	2.82	2.82	2.81	2.81	2.81	2.81	11.6	14.1	15.3	19.0	21.5	25.3	0.20	0.24	0.26	0.32	0.37	0.43
WT_1000/152x8	2.82	2.82	2.82	2.82	2.82	2.81	12.9	15.4	16.6	20.3	22.8	26.5	0.22	0.26	0.28	0.35	0.39	0.45
WT_1000/152x10	2.83	2.83	2.83	2.82	2.82	2.82	14.2	16.7	17.9	21.6	24.1	27.8	0.24	0.28	0.31	0.37	0.41	0.47
WT_1000/178x10	2.91	2.90	2.90	2.90	2.90	2.90	15.1	17.6	18.8	22.4	24.8	28.4	0.26	0.30	0.32	0.38	0.42	0.48
WT_1000/152x13	2.84	2.84	2.84	2.84	2.84	2.83	16.8	19.3	20.5	24.2	26.7	30.4	0.29	0.33	0.35	0.41	0.45	0.52
WT_1000/178x13	2.92	2.92	2.92	2.91	2.91	2.91	18.1	20.5	21.7	25.3	27.7	31.3	0.31	0.35	0.37	0.43	0.47	0.53
WT_1000/203x13	2.99	2.99	2.99	2.99	2.99	2.99	19.3	21.7	22.9	26.4	28.7	32.2	0.33	0.37	0.39	0.45	0.49	0.55
WT_1000/152x19	2.87	2.87	2.87	2.86	2.86	2.86	22.0	24.4	25.6	29.3	31.8	35.4	0.37	0.42	0.44	0.50	0.54	0.60
WT_1000/203x16	3.01	3.01	3.01	3.00	3.00	3.00	22.6	25.0	26.1	29.6	32.0	35.5	0.39	0.43	0.45	0.50	0.54	0.60
WT_1000/203x19	3.02	3.02	3.02	3.02	3.01	3.01	25.9	28.2	29.4	32.9	35.2	38.7	0.44	0.48	0.50	0.56	0.60	0.66
WT_1000/254x19	3.17	3.17	3.17	3.17	3.17	3.16	29.4	31.6	32.8	36.1	38.3	41.6	0.50	0.54	0.56	0.61	0.65	0.71
WT_1000/203x25	3.05	3.04	3.04	3.04	3.04	3.04	32.3	34.6	35.8	39.2	41.6	45.0	0.55	0.59	0.61	0.67	0.71	0.77
WT_1000/254x25	3.20	3.20	3.20	3.19	3.19	3.19	37.1	39.3	40.4	43.7	45.9	49.2	0.63	0.67	0.69	0.74	0.78	0.84
WT_1000/279x25	3.27	3.27	3.27	3.27	3.27	3.27	39.3	41.5	42.6	45.8	48.0	51.2	0.67	0.71	0.73	0.78	0.82	0.87
WT_1000/305x25	3.35	3.35	3.35	3.35	3.34	3.34	41.5	43.6	44.6	47.8	49.9	53.0	0.71	0.74	0.76	0.81	0.85	0.90
WT_1000/254x32	3.22	3.22	3.22	3.22	3.22	3.21	44.7	46.9	48.0	51.2	53.4	56.7	0.76	0.80	0.82	0.87	0.91	0.97
WT_1000/330x25	3.43	3.42	3.42	3.42	3.42	3.42	43.5	45.6	46.6	49.7	51.7	54.8	0.74	0.78	0.79	0.85	0.88	0.93
WT_1000/356x25	3.50	3.50	3.50	3.50	3.50	3.49	45.5	47.5	48.5	51.5	53.5	56.5	0.77	0.81	0.83	0.88	0.91	0.96
WT_1000/305x32	3.38	3.37	3.37	3.37	3.37	3.37	50.2	52.3	53.3	56.4	58.5	61.7	0.85	0.89	0.91	0.96	1.00	1.05
WT_1000/406x25	3.66	3.65	3.65	3.65	3.65	3.65	49.1	51.0	52.0	54.9	56.8	59.7	0.84	0.87	0.89	0.93	0.97	1.02
WT_1000/356x32	3.53	3.53	3.53	3.52	3.52	3.52	55.2	57.2	58.2	61.2	63.2	66.2	0.94	0.97	0.99	1.04	1.08	1.13
WT_1000/406x32	3.68	3.68	3.68	3.68	3.67	3.67	59.8	61.7	62.7	65.5	67.5	70.3	1.02	1.05	1.07	1.12	1.15	1.20
WT_1000/450x32	3.81	3.81	3.81	3.81	3.81	3.80	63.4	65.3	66.2	69.0	70.9	73.6	1.08	1.11	1.13	1.18	1.21	1.25

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in

Highlight M/D < 23.00 kg/m / m

Surf Area = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}

The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m²) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_ 1219/127x6	3.25	3.25	3.25	3.25	3.25	3.24	10.4	13.0	14.3	18.3	20.9	24.8	0.18	0.22	0.24	0.31	0.36	0.42
WT_ 1219/152x6	3.33	3.33	3.33	3.32	3.32	3.32	10.9	13.5	14.8	18.6	21.2	25.0	0.19	0.23	0.25	0.32	0.36	0.43
WT_ 1219/152x8	3.34	3.33	3.33	3.33	3.33	3.33	12.1	14.6	15.9	19.7	22.3	26.1	0.21	0.25	0.27	0.34	0.38	0.45
WT_ 1219/152x10	3.34	3.34	3.34	3.34	3.34	3.33	13.2	15.7	17.0	20.8	23.4	27.2	0.22	0.27	0.29	0.35	0.40	0.46
WT_ 1219/178x10	3.42	3.42	3.42	3.41	3.41	3.41	14.0	16.5	17.7	21.5	24.0	27.7	0.24	0.28	0.30	0.37	0.41	0.47
WT_ 1219/152x13	3.35	3.35	3.35	3.35	3.35	3.35	15.4	17.9	19.2	23.0	25.6	29.4	0.26	0.31	0.33	0.39	0.44	0.50
WT_ 1219/178x13	3.43	3.43	3.43	3.43	3.42	3.42	16.5	19.0	20.3	24.0	26.5	30.2	0.28	0.32	0.34	0.41	0.45	0.51
WT_ 1219/203x13	3.51	3.51	3.50	3.50	3.50	3.50	17.6	20.0	21.3	24.9	27.3	31.0	0.30	0.34	0.36	0.42	0.47	0.53
WT_ 1219/152x19	3.38	3.38	3.38	3.38	3.37	3.37	19.8	22.3	23.6	27.3	29.9	33.7	0.34	0.38	0.40	0.47	0.51	0.57
WT_ 1219/203x16	3.52	3.52	3.52	3.52	3.51	3.51	20.4	22.8	24.1	27.7	30.1	33.8	0.35	0.39	0.41	0.47	0.51	0.58
WT_ 1219/203x19	3.53	3.53	3.53	3.53	3.53	3.52	23.2	25.6	26.8	30.5	32.9	36.5	0.40	0.44	0.46	0.52	0.56	0.62
WT_ 1219/254x19	3.68	3.68	3.68	3.68	3.68	3.68	26.4	28.7	29.9	33.3	35.7	39.1	0.45	0.49	0.51	0.57	0.61	0.67
WT_ 1219/203x25	3.56	3.56	3.56	3.55	3.55	3.55	28.7	31.1	32.3	36.0	38.4	42.0	0.49	0.53	0.55	0.61	0.65	0.71
WT_ 1219/254x25	3.71	3.71	3.71	3.71	3.70	3.70	33.0	35.3	36.5	39.9	42.3	45.7	0.56	0.60	0.62	0.68	0.72	0.78
WT_ 1219/279x25	3.79	3.78	3.78	3.78	3.78	3.78	35.0	37.3	38.4	41.8	44.1	47.5	0.60	0.64	0.65	0.71	0.75	0.81
WT_ 1219/305x25	3.86	3.86	3.86	3.86	3.86	3.85	37.0	39.2	40.3	43.6	45.8	49.2	0.63	0.67	0.69	0.74	0.78	0.84
WT_ 1219/254x32	3.74	3.73	3.73	3.73	3.73	3.73	39.6	41.9	43.0	46.5	48.8	52.2	0.67	0.71	0.73	0.79	0.83	0.89
WT_ 1219/330x25	3.94	3.94	3.94	3.93	3.93	3.93	38.8	41.0	42.1	45.3	47.5	50.8	0.66	0.70	0.72	0.77	0.81	0.87
WT_ 1219/356x25	4.02	4.01	4.01	4.01	4.01	4.01	40.6	42.7	43.8	47.0	49.1	52.4	0.69	0.73	0.75	0.80	0.84	0.89
WT_ 1219/305x32	3.89	3.89	3.89	3.88	3.88	3.88	44.5	46.7	47.8	51.2	53.4	56.7	0.76	0.80	0.81	0.87	0.91	0.97
WT_ 1219/406x25	4.17	4.17	4.17	4.16	4.16	4.16	44.0	46.0	47.1	50.2	52.2	55.3	0.75	0.78	0.80	0.85	0.89	0.94
WT_ 1219/356x32	4.04	4.04	4.04	4.04	4.03	4.03	49.1	51.2	52.3	55.5	57.6	60.8	0.84	0.87	0.89	0.95	0.98	1.04
WT_ 1219/406x32	4.19	4.19	4.19	4.19	4.19	4.18	53.4	55.4	56.5	59.5	61.6	64.6	0.91	0.94	0.96	1.01	1.05	1.10
WT_ 1219/450x32	4.32	4.32	4.32	4.32	4.32	4.32	56.8	58.8	59.8	62.8	64.7	67.7	0.97	1.00	1.02	1.07	1.10	1.15

SINBEAM LIGHTER BY DESIGN

SIN Beam M/D for ULC

Highlight W/D < 0.37 lb/ft / in
Highlight M/D < 23.00 kg/m / m

Surf Area = 3 * W_{Flange} + 4 * T_{Flange} + 2 * D_{Web} * 1.169 - 2 * T_{web}
The 1.169 factor is to account for the sinusoidal shape of the web

Designation	Surface Area (m^2) per metre length less top flange						Metric M/D Ratio (kg/m / m)						Imperial W/D Ratio (lb/ft / in)					
	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK	WTA	WTB	WTC	WTF	WTH	WTK
a	c	d	e	f	g	h	j	k	l	m	n	o	q	r	s	t	u	v
WT_1500/127x6	3.91	3.91	3.91	3.91	3.90	3.90	9.9	12.6	13.9	18.0	20.6	24.7	0.17	0.21	0.24	0.31	0.35	0.42
WT_1500/152x6	3.99	3.98	3.98	3.98	3.98	3.98	10.4	13.0	14.3	18.3	20.9	24.8	0.18	0.22	0.24	0.31	0.36	0.42
WT_1500/152x8	3.99	3.99	3.99	3.99	3.99	3.98	11.3	13.9	15.2	19.2	21.8	25.8	0.19	0.24	0.26	0.33	0.37	0.44
WT_1500/152x10	4.00	4.00	4.00	3.99	3.99	3.99	12.2	14.9	16.2	20.1	22.7	26.7	0.21	0.25	0.28	0.34	0.39	0.45
WT_1500/178x10	4.07	4.07	4.07	4.07	4.07	4.07	12.9	15.5	16.8	20.7	23.2	27.1	0.22	0.26	0.29	0.35	0.40	0.46
WT_1500/152x13	4.01	4.01	4.01	4.01	4.01	4.00	14.1	16.7	18.0	21.9	24.5	28.5	0.24	0.28	0.31	0.37	0.42	0.49
WT_1500/178x13	4.09	4.09	4.09	4.08	4.08	4.08	15.1	17.6	18.9	22.8	25.3	29.2	0.26	0.30	0.32	0.39	0.43	0.50
WT_1500/203x13	4.16	4.16	4.16	4.16	4.16	4.16	16.0	18.5	19.8	23.6	26.1	29.9	0.27	0.32	0.34	0.40	0.44	0.51
WT_1500/152x19	4.04	4.04	4.03	4.03	4.03	4.03	17.8	20.4	21.7	25.6	28.2	32.1	0.30	0.35	0.37	0.44	0.48	0.55
WT_1500/203x16	4.18	4.17	4.17	4.17	4.17	4.17	18.4	20.9	22.2	25.9	28.4	32.2	0.31	0.36	0.38	0.44	0.48	0.55
WT_1500/203x19	4.19	4.19	4.19	4.18	4.18	4.18	20.7	23.2	24.5	28.3	30.8	34.5	0.35	0.40	0.42	0.48	0.52	0.59
WT_1500/254x19	4.34	4.34	4.34	4.34	4.34	4.33	23.5	25.9	27.1	30.8	33.2	36.8	0.40	0.44	0.46	0.52	0.57	0.63
WT_1500/203x25	4.21	4.21	4.21	4.21	4.21	4.21	25.4	27.9	29.2	32.9	35.4	39.1	0.43	0.48	0.50	0.56	0.60	0.67
WT_1500/254x25	4.37	4.37	4.36	4.36	4.36	4.36	29.2	31.6	32.8	36.4	38.8	42.4	0.50	0.54	0.56	0.62	0.66	0.72
WT_1500/279x25	4.44	4.44	4.44	4.44	4.44	4.43	31.0	33.3	34.5	38.1	40.4	44.0	0.53	0.57	0.59	0.65	0.69	0.75
WT_1500/305x25	4.52	4.52	4.52	4.51	4.51	4.51	32.7	35.0	36.2	39.7	42.0	45.5	0.56	0.60	0.62	0.68	0.72	0.77
WT_1500/254x32	4.39	4.39	4.39	4.39	4.39	4.38	34.8	37.2	38.4	42.0	44.4	48.0	0.59	0.63	0.65	0.71	0.76	0.82
WT_1500/330x25	4.60	4.59	4.59	4.59	4.59	4.59	34.3	36.6	37.8	41.2	43.5	46.9	0.58	0.62	0.64	0.70	0.74	0.80
WT_1500/356x25	4.67	4.67	4.67	4.67	4.67	4.66	35.9	38.2	39.3	42.7	45.0	48.3	0.61	0.65	0.67	0.73	0.77	0.82
WT_1500/305x32	4.54	4.54	4.54	4.54	4.54	4.54	39.2	41.5	42.7	46.1	48.4	51.9	0.67	0.71	0.73	0.79	0.83	0.88
WT_1500/406x25	4.82	4.82	4.82	4.82	4.82	4.82	39.0	41.2	42.3	45.6	47.7	51.0	0.66	0.70	0.72	0.78	0.81	0.87
WT_1500/356x32	4.70	4.70	4.69	4.69	4.69	4.69	43.3	45.5	46.7	50.0	52.3	55.6	0.74	0.78	0.79	0.85	0.89	0.95
WT_1500/406x32	4.85	4.85	4.85	4.84	4.84	4.84	47.2	49.3	50.4	53.7	55.9	59.1	0.80	0.84	0.86	0.91	0.95	1.01
WT_1500/450x32	4.98	4.98	4.98	4.98	4.97	4.97	50.3	52.4	53.5	56.6	58.8	61.9	0.86	0.89	0.91	0.96	1.00	1.05

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4 SAMPLE DETAILS

4.1 Shear Connections

4.2 Moment Connections

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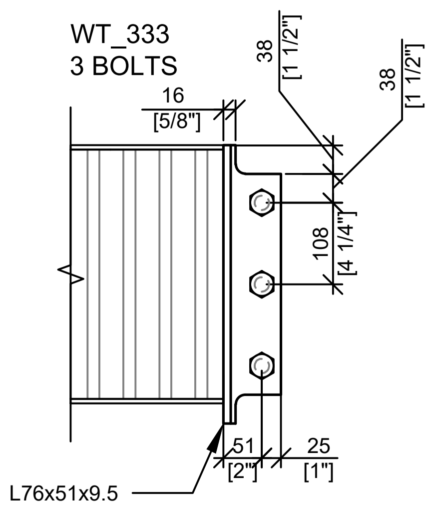
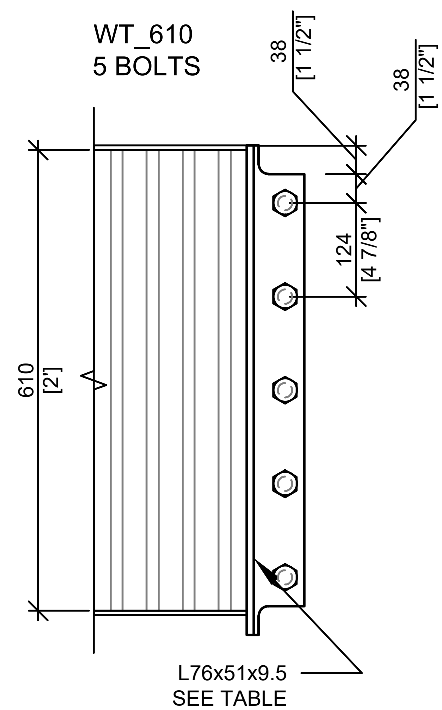
STEELCON FABRICATION

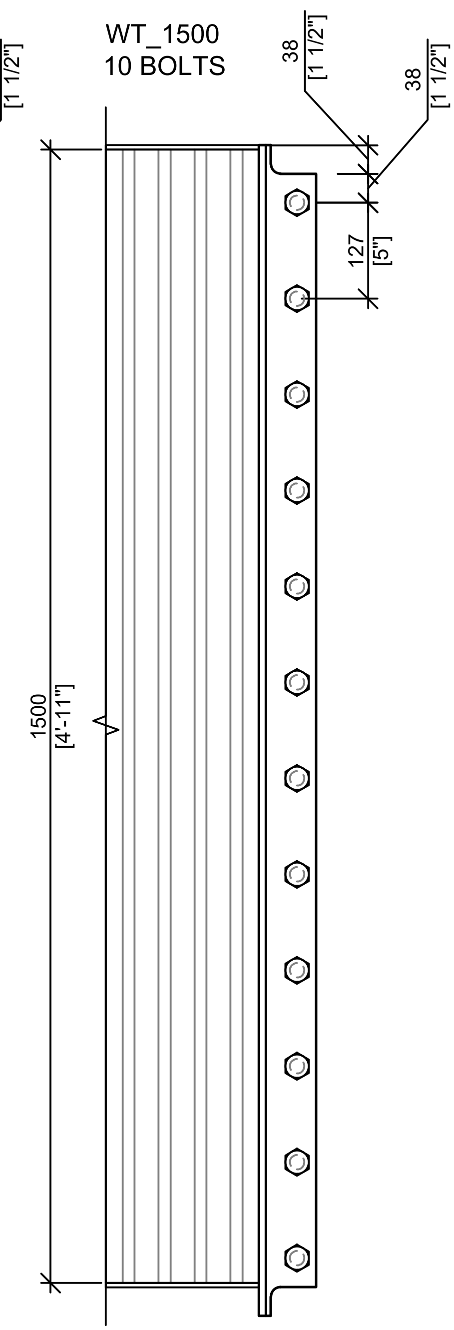
62 PROGRESS CRT. BRAMPTON ONT L6S-5X2

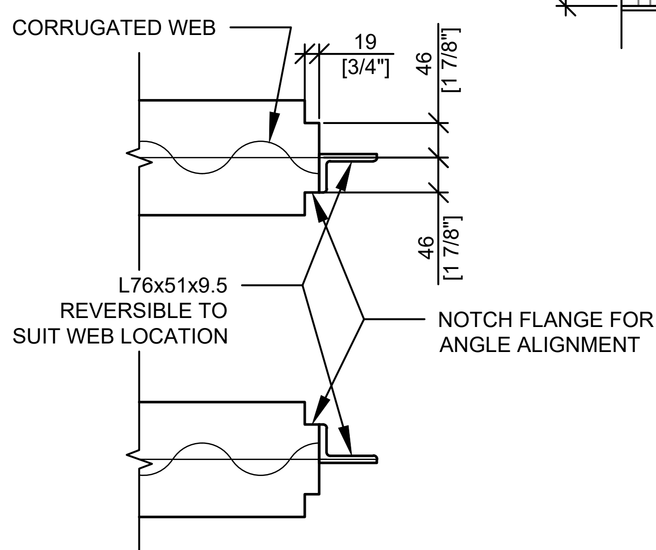
TEL: (416) 798-3343 FAX: (416) 798-2922

JOB:	SIN BEAM	DATE:	2019-05-15
TITLE:	SHEAR CONNECTION		
	ANGLE - NO AXIAL LOAD	SHEET:	SK-1.01









PLAN VIEW

NUMBER OF BOLTS

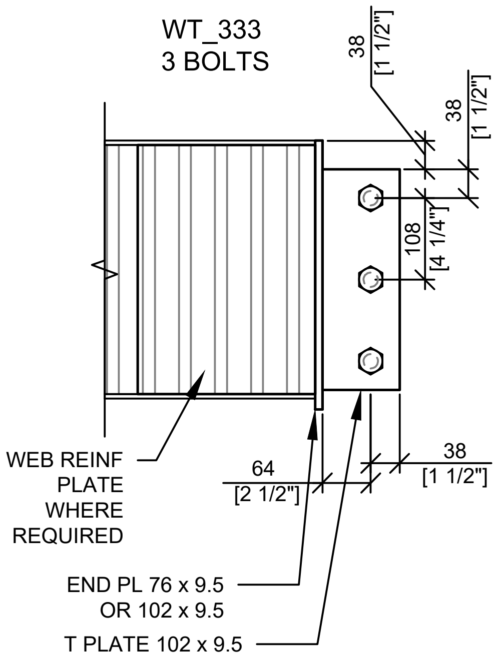
SIN BEAM DEPTH		# BOLTS	BOLT SPACING	ANGLE LENGTH
(mm)	(in)	19mm (¾") Ø	(mm)	(mm)
333	13.11	3	108	368
500	19.69	4	127	533
610	24.00	5	124	648
750	29.53	6	127	787
900	35.43	7	130	933
1219	48.00	10	124	1267
1500	59.06	12	127	1549

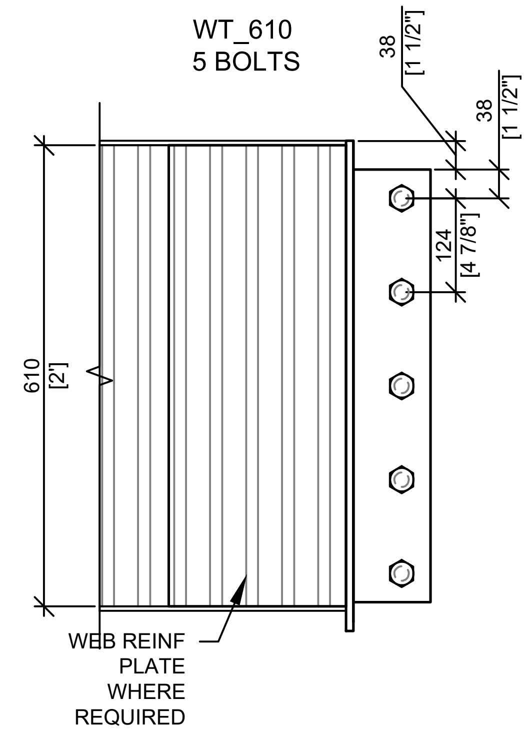
STEELCON FABRICATION

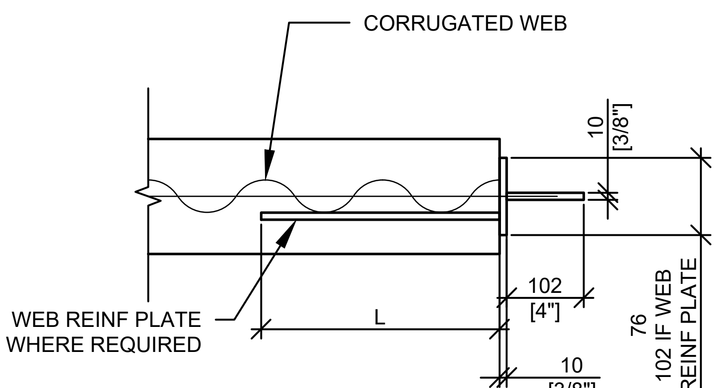
62 PROGRESS CRT. BRAMPTON ONT L6S-5X2
TEL: (416) 798-3343 FAX: (416) 798-2922

STEELCON FABRICATION INC.

JOB:	SIN BEAM	DATE:	2019-05-15
TITLE:	SHEAR CONNECTION		
	T PLATE - NO AXIAL LOAD	SHEET:	SK-1.02







PLAN VIEW

NUMBER OF BOLTS				
SIN BEAM DEPTH		# BOLTS	BOLT SPACING	ANGLE LENGTH
(mm)	(in)	19mm (¾") Ø	(mm)	(mm)
333	13.11	3	108	368
500	19.69	4	127	533
610	24.00	5	124	648
750	29.53	6	127	787
900	35.43	7	130	933
1219	48.00	10	124	1267
1500	59.06	12	127	1549

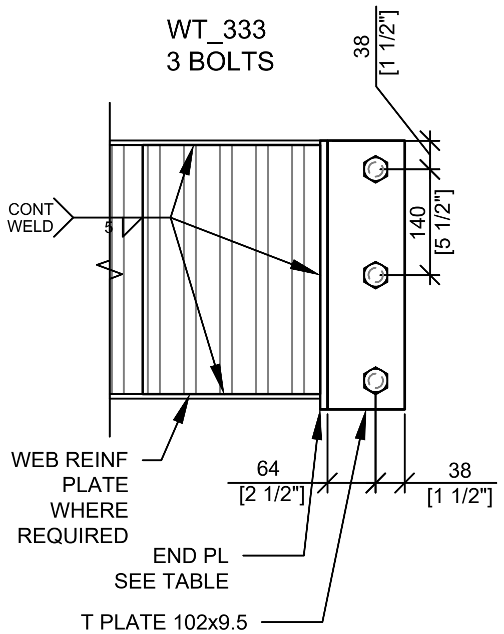
STEELCON FABRICATION INC.

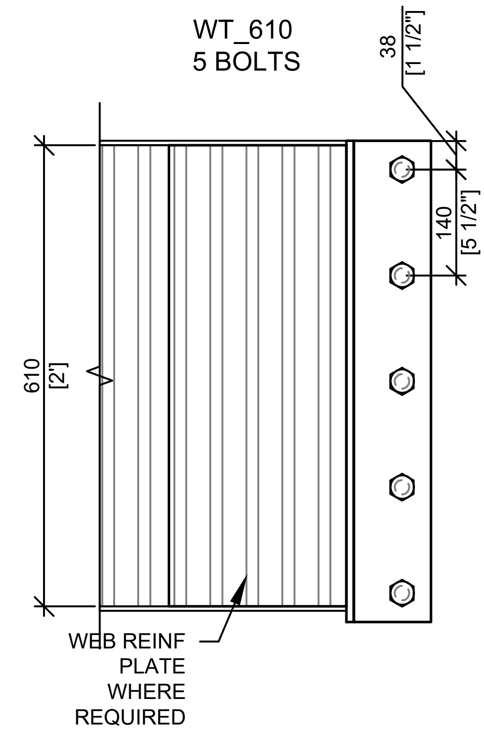
STEELCON FABRICATION

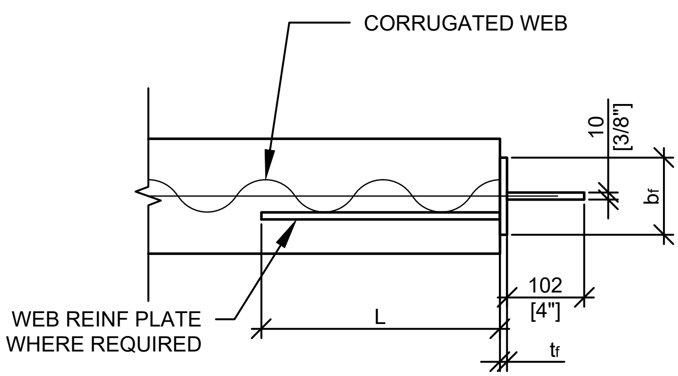
62 PROGRESS CRT. BRAMPTON ONT L6S-5X2

TEL: (416) 798-3343 FAX: (416) 798-2922

JOB:	SIN BEAM	DATE:	2019-05-15
TITLE:	SHEAR CONNECTION WITH SIN BEAM AXIAL LOAD	SHEET:	SK-1.03





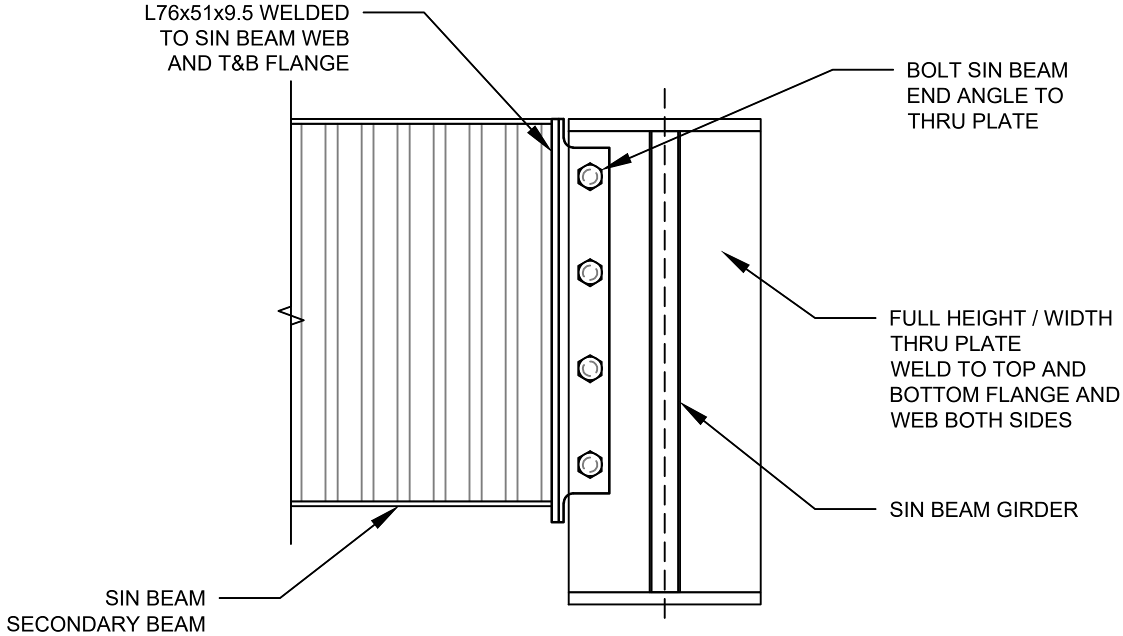


PLAN VIEW

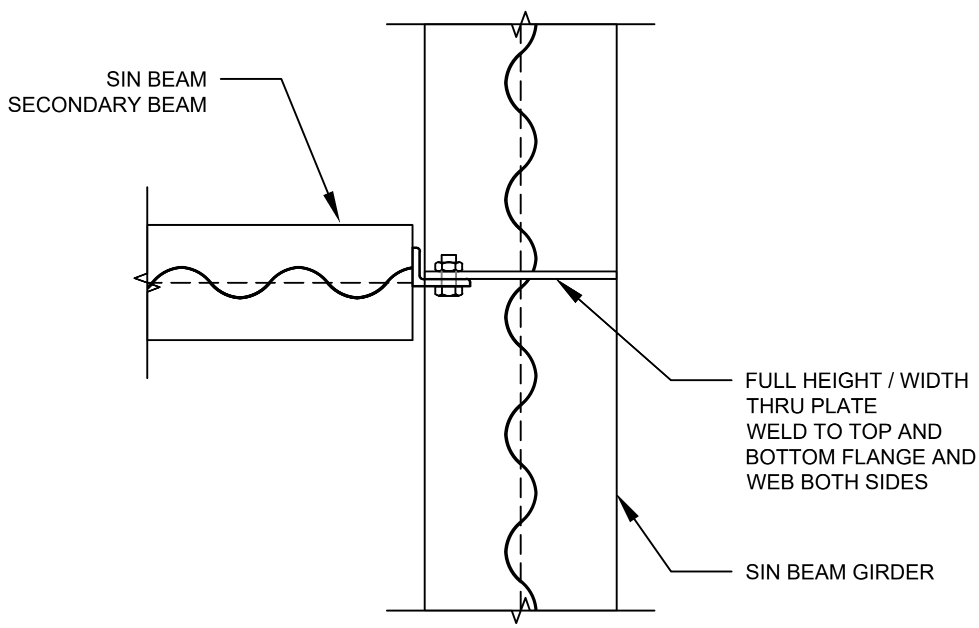
MIN NUMBER OF BOLTS		
SIN BEAM DEPTH		# BOLTS MINIMUM
(mm)	(in)	19mm (¾") Ø
333	13.11	3
500	19.69	4
610	24.00	5
750	29.53	6
900	35.43	7
1219	48.00	10
1500	59.06	12

FD SHEAR / AXIAL CONNECTIONS			
	b (mm)	t_f (mm)	WEB REINF PLATE
FD1	76	10	NO
FD2	102	10	YES
FD3	102	13	YES
FD4	102	16	YES

STEELCON FABRICATION	JOB:	SIN BEAM	DATE:	2020-10-01
62 PROGRESS CRT. BRAMPTON ONT L6S-5X2 TEL: (416) 798-3343 FAX: (416) 798-2922	TITLE:	SIN BEAM TO SIN BEAM SHEAR CONNECTION	SHEET:	SK-1.04



SECTION
SIN BEAM TO SIN BEAM
SHEAR CONNECTION



FOR NUMBER OF BOLTS REFER TO SIN BEAM TO HSS COLUMN BOLTING TABLE USING THE DEPTH OF THE SECONDARY BEAM

PLAN
SIN BEAM TO SIN BEAM
SHEAR CONNECTION

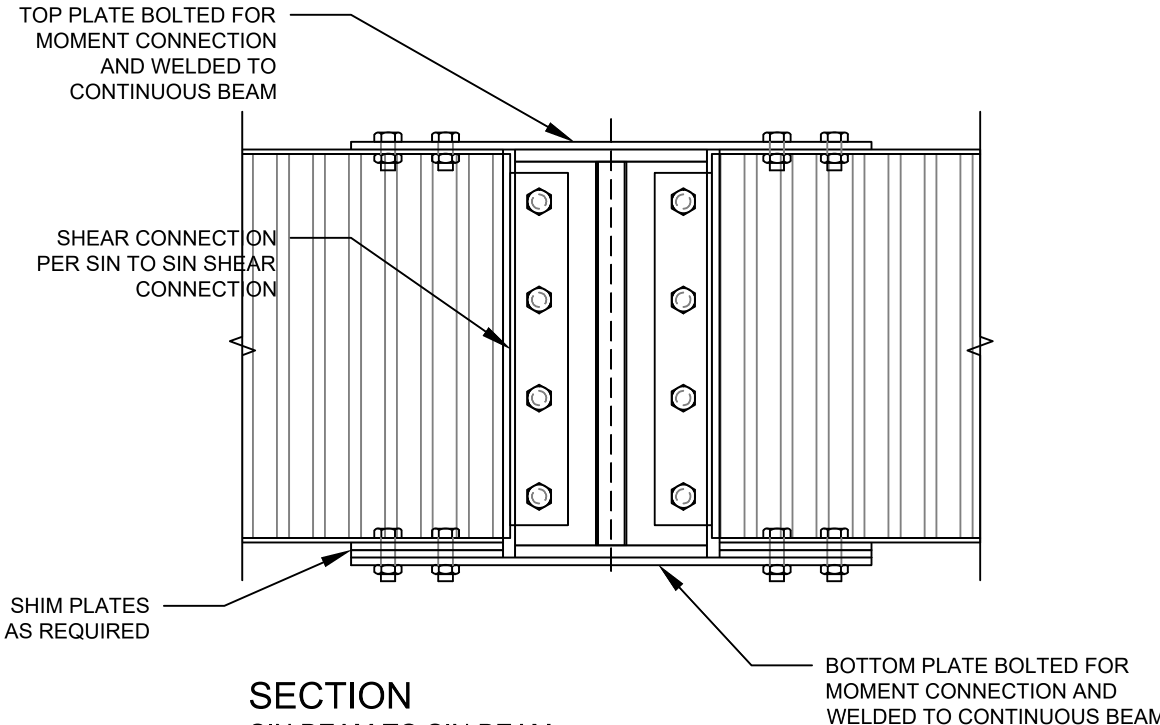
STEELCON
FABRICATION INC.

STEELCON FABRICATION

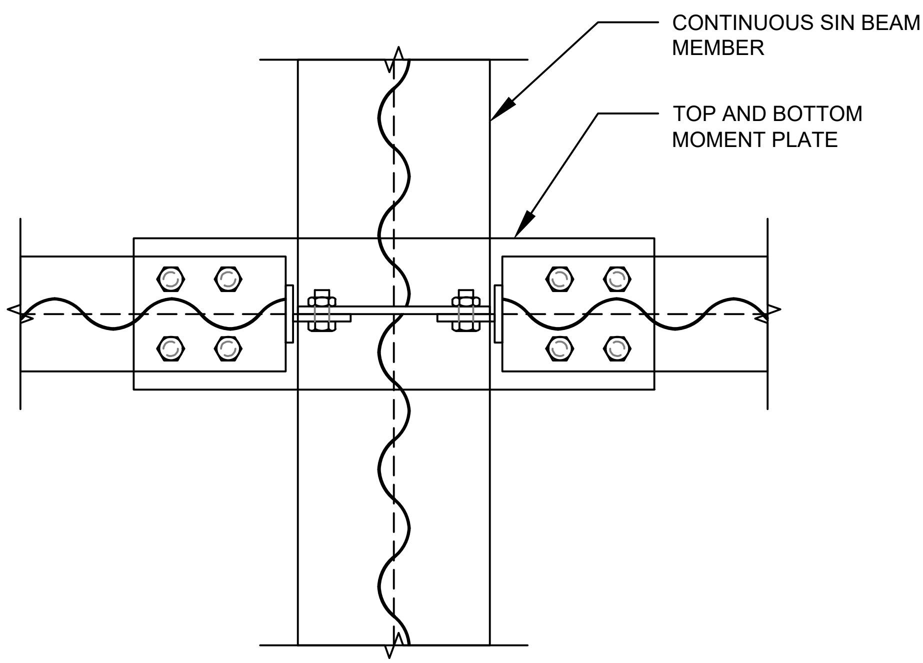
62 PROGRESS CRT. BRAMPTON ONT L6S-5X2

TEL: (416) 798-3343 FAX: (416) 798-2922

JOB:	SIN BEAM	DATE:	2020-10-01
TITLE:	SIN BEAM TO SIN BEAM MOMENT CONNECTION	SHEET:	SK-2.01



SECTION
SIN BEAM TO SIN BEAM
MOMENT CONNECTION



SIN BEAM MEMBERS SHOULD HAVE SAME WEB DEPTH, SHIM PLATES REQUIRED TO MAKE UP DIFFERENCE IN FLANGE THICKNESS

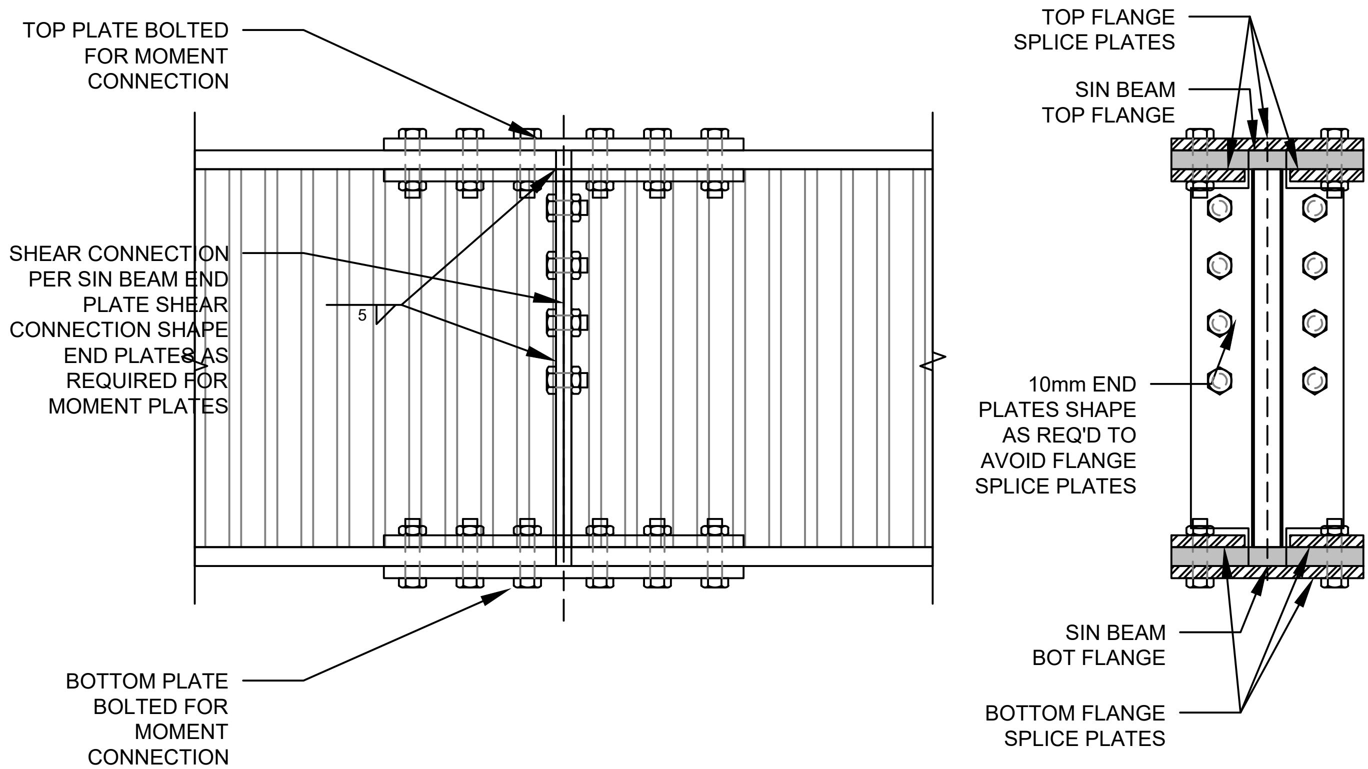
PLAN
SIN BEAM TO SIN BEAM
MOMENT CONNECTION

STEELCON FABRICATION

62 PROGRESS CRT. BRAMPTON ONT L6S-5X2

TEL: (416) 798-3343 FAX: (416) 798-2922

JOB:	SIN BEAM	DATE:	2020-10-01
TITLE:	SIN BEAM SPLICE DETAIL	SHEET:	SK-2.02



BEAM SPLICE

SIN BEAM SPLICE MOMENT CONNECTION

5 REFERENCES / CERTIFICATION

5.1 CWB Certification for Steelcon - SIN Beam Welding

5.2 European Code 1993-1-5:2005 Annex D Plate Girders with Corrugated Webs

5.3 Annex D – Commentary

5.4 Flange Buckling Behavior of H-Shaped Member with Sinusoidal Webs - 2008

5.5 Shear Load Testing Results - Professor R.M. Schuster - Nov 2016

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STEELCON FABRICATION INC.

62 Progress Court
Brampton, Ontario

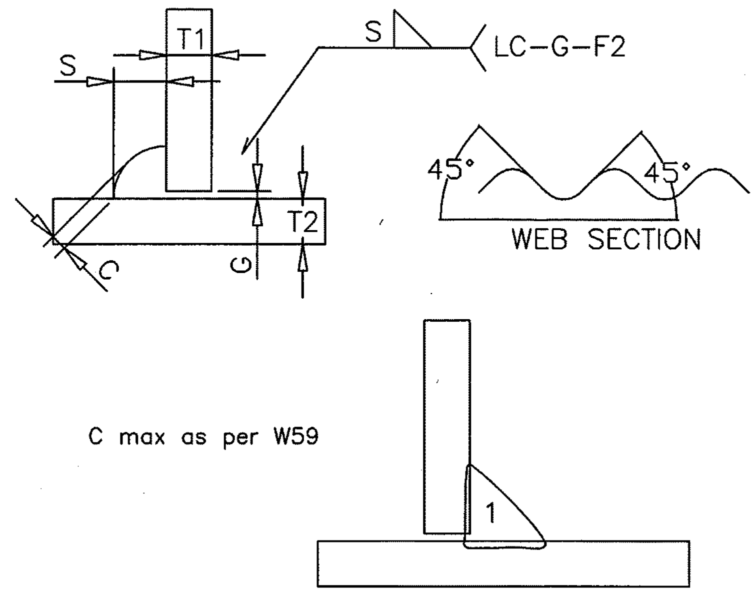
DATE:	August 18, 2015
Data Sheet No:	**LC-G-F2**
WPS No:	LC-GMAW
PQR #	61AG1605021314
Date Qualified:	May 2, 2016
Applicable Standards:	CSA W47.1, W59 / AWS D1.3

Base Material Designation
AWS D1.3 – Table 1.2 Group I and II **to** CSA W59*Table 11-1 Group 1, 2, 3 , CSA G40.21 44W, 50W

Filler Metal / Classification
ISO 14341 / B-G 49A 3 C G6

Process:	GMAW automatic robot
Joint:	FILLET tee
Penetration:	N / A
Position:	2F to 45° SLOPE UP AND DOWN
Root Opening	G = 0
Effective Throat Thickness:	ETT = 0.7 S
Single or Multi-pass	SINGLE PASS
Backing Material	NONE
Root Prep. Sec. Side:	N / A
Peening	NONE
Bead	STRINGER
Shielding Gas/Flux:	85%Ar + 15%CO_2
Nozzle Size	16 mm
Gas Flow:	15 l / min – 35 CFH
Transfer Mode	GLOBULAR / SPRAY
Electrode Stickout:	16 to 20 mm
Cleaning	BRUSHING / GRINDING
Interpass Cleaning	N / A
Preheating / Interpass Temp.	10°C Min.
Interpass Temperature max:	250°C max
Postweld Heat Treatment Temp.:	NONE
Postweld Heat Treatment Time:	

Joint Details



WELD SIZE S mm	WELD SIZE S inch	Web Ga.	Position	LAYER	PASS	EL. SIZE mm	CURRENT POLARITY	**AMPS**	WIRE SPEED m / min	**VOLTS**	ARC TRAVEL cm / min
3.7	0.150	14	2F	1	1	1.0	DCEP	110	8.0-8.2	19.0	55-59
			45° UP	1	1	1.0		100	4.7-4.8	19.0	55-59
			45° DOWN	1	1	1.0		185	8.8-9.0	19.0	55-59
4	5/32	12-11	2F	1	1	1.0		120	8.3-8.5	20.0	52-56
			45° UP	1	1	1.0		110	5.0-5.2	20.0	52-56
			45° DOWN	1	1	1.0		195	9.1-9.3	20.0	52-56

NOTES: Procedure for robot producing SIN beams; welded beam with thin gauge web formed to sinusoidal wave shape with max slope 45°
Feeder varies parameters automatically for horizontal, uphill or downhill welding.
Flange thickness range 6 – 32mm;
*Any combination of equivalent AWS or ASTM steels is permitted.

NOTES:
22-March-2016 revised; previous limit on material thickness not applicable to product. Procedure requires to join gauge webs to plate flanges.
29-March-2016 revised; remove 16ga. web material. Change in shielding gas.
22-May-2016 modified as per PQR# 61AG1605021314

12g-f-2F-01

SIGNED
NAME
TITLE
DATE

CWB Accepted
CWB
May 27, 2016
Valid only if welding consumables are certified by the CWB

On the basis of
PROCEDURE QUALIFICATION

APPROVAL
LICENSED PROFESSIONAL ENGINEER
R. SMEJKAL
22-MAY-2016
PROVINCE OF ONTARIO

STEELCON FABRICATION INC.

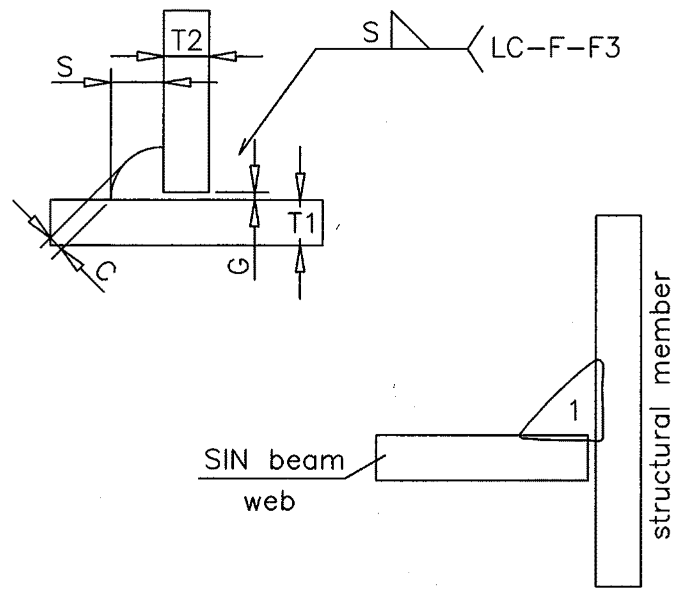
62 Progress Court
Brampton, Ontario

DATE:	April 3, 2016
Data Sheet No:	**LC-F-F3**
WPS No:	LC-FCAW
PQR #	61AG1605101023
Date Qualified:	May 10, 2016
Applicable Standards:	CSA W47.1, W59 / AWS D1.3

Base Material Designation	Filler Metal / Classification
AWS D1.3 – Table 1.2 Group I and II* **to** CSA W59 Table 11-1 Group 1, 2, 3, CSA G40.21 44W, 50W	CSA W48 / E491T-9 or E492T-9 H8 max

Process:	FCAW semi-auto
Joint:	FILLET tee
Penetration:	N / A
Position:	2F
Root Opening	G = 0
Effective Throat Thickness:	E = 0.7 S
Single or Multi-pass	SINGLE
Backing Material	NONE
Root Prep. Sec. Side:	N / A
Peening	NONE
Bead	STRINGER
Shielding Gas/Flux:	CO_2
Nozzle Size	16 mm
Gas Flow:	15 l / min – 35 CFH
Transfer Mode	Globular / SPRAY
Electrode Stickout:	16 - 22 mm
Cleaning	BRUSHING / GRINDING
Interpass Cleaning	BRUSHING
Preheating / Interpass Temp.	AS PER W59 Table 5-3
Interpass Temperature max:	250°C max
Postweld Heat Treatment Temp.:	NONE
Postweld Heat Treatment Time:	

Joint Details



WELD SIZE S mm	WELD SIZE S inch	Process	SIDE	LAYER	PASS	EL. SIZE mm	CURRENT POLARITY	AMPS	WIRE SPEED m / min	VOLTS	ARC TRAVEL cm / min
5	3/16	FCAW		1	1	1.6	DCEP	200 - 225	4.0-4.5	23-26	58-63

NOTE: Procedure for joining SIN beam web to structural attachments, and repair of weld at web to flange joint
Flange or structural attachment thickness range 5 – 32mm; SIN beam web thickness 14 to 11 gauge.
*Any combination of equivalent AWS or ASTM steels is permitted

NOTES:
22-May-2016 modified as per PQR# 61AG1605101023

SIGNED
NAME
TITLE
DATE

CWB Accepted
May 27, 2016
Valid only if welding consumables are certified by the CWB

On the basis of PROCEDURE QUALIFICATION

APPROVAL
LICENSED PROFESSIONAL ENGINEER
R. SMEJKAL
22-MAY-2016
PROVINCE OF ONTARIO

16f-f-2F-01

Annex D [informative] – Plate girders with corrugated webs

D.1 General

(1) Annex D covers design rules for I-girders with trapezoidally or sinusoidally corrugated webs, see Figure D.1.

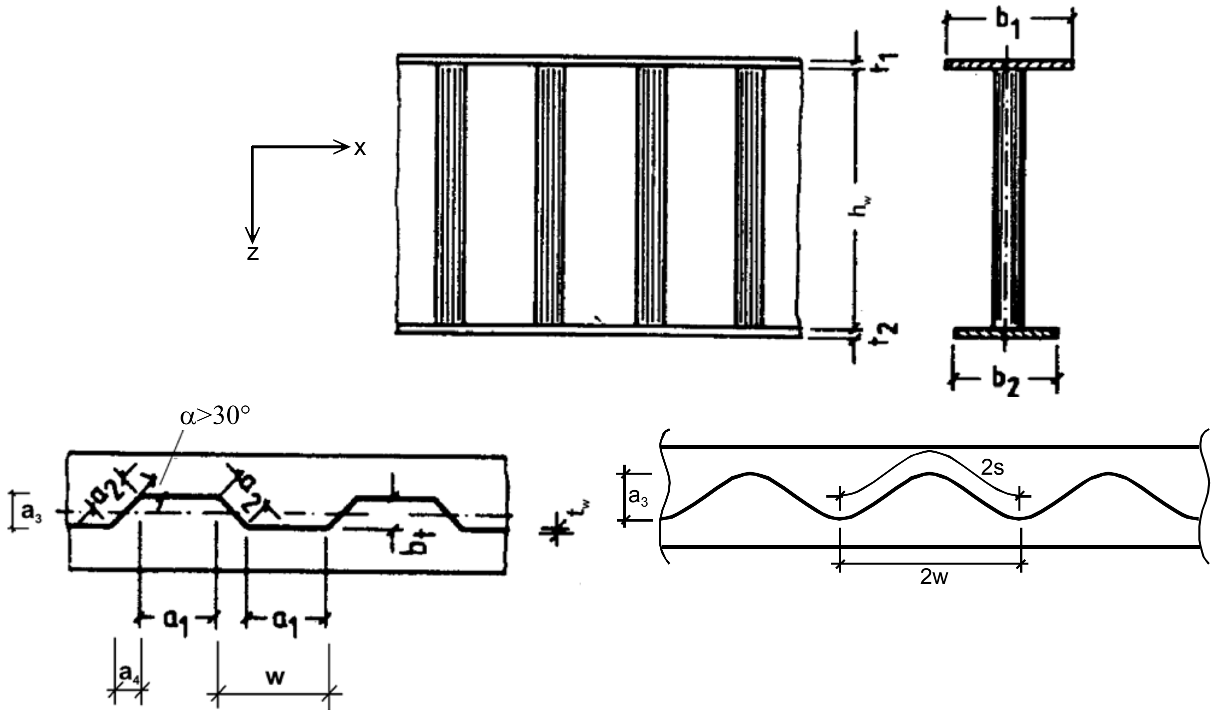


Figure D.1: Geometric notations

D.2 Ultimate limit state

D.2.1 Moment of resistance

(1) The moment of resistance M_{Rd} due to bending should be taken as the minimum of the following:

$$M_{Rd} = \min\left\{ \underbrace{\frac{b_2 t_2 f_{yw,r}}{\gamma_{M0}}\left(h_w + \frac{t_1 + t_2}{2}\right)}_{\text{tension flange}} ; \underbrace{\frac{b_1 t_1 f_{yw,r}}{\gamma_{M0}}\left(h_w + \frac{t_1 + t_2}{2}\right)}_{\text{compression flange}} ; \underbrace{\frac{b_1 t_1 \chi f_{yw}}{\gamma_{M1}}\left(h_w + \frac{t_1 + t_2}{2}\right)}_{\text{compression flange}} \right\} \quad \text{(D.1)}$$

where $f_{yw,,r}$ is the value of yield stress reduced due to transverse moments in the flanges

$f_{y,w,r} = f_{yw}\, f_T$

$$f_T = 1 - 0{,}4\sqrt{\frac{\sigma_x(M_z)}{\frac{f_{yf}}{\gamma_{M0}}}}$$

$\sigma_x(M_z)$ is the stress due to the transverse moment in the flange

χ is the reduction factor for out of plane buckling according to 6.3 of EN 1993-1-1

NOTE 1 The transverse moment M_z results from the shear flow in flanges as indicated in Figure D.2.

NOTE 2 For sinusoidally corrugated webs f_T is 1,0.

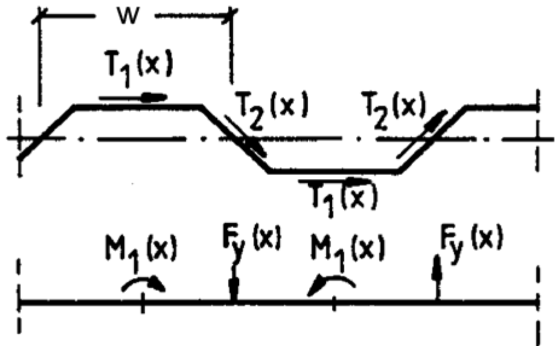


Figure D.2: Transverse moments M_z due to shear flow introduction into the flange

(2) The effective area of the compression flange should be determined from 4.4(1) and (2) using the larger value of the slenderness parameter $\bar{\lambda}_p$ defined in 4.4(2) and the buckling factor k_σ taken as:

a) $$k_\sigma = 0{,}43 + \left(\frac{b}{a}\right)^2 \quad \text{(D.2)}$$

where b is the maximum width of the outstand from the toe of the weld to the free edge

$a = a_1 + 2a_4$

b) $$k_\sigma = 0{,}60 \quad \text{(D.3)}$$

where $b = \dfrac{b_1}{2}$

D.2.2 Shear resistance

(1) The shear resistance V_{Rd} should be taken as:

$$V_{Rd} = \chi_c \frac{f_{yw}}{\gamma_{M1}\sqrt{3}} h_w t_w \quad \text{(D.4)}$$

where χ_c is the lesser of the values of reduction factors for local buckling $\chi_{c,\ell}$ and global buckling $\chi_{c,g}$ obtained from (2) and (3)

(2) The reduction factor $\chi_{c,\ell}$ for local buckling should be calculated from:

$$\chi_{c,\ell} = \frac{1{,}15}{0{,}9 + \bar{\lambda}_{c,\ell}} \leq 1{,}0 \quad \text{(D.5)}$$

where $$\bar{\lambda}_{c,\ell} = \sqrt{\frac{f_y}{\tau_{cr,\ell}\sqrt{3}}} \quad \text{(D.6)}$$

$$\tau_{cr,\ell} = 4{,}83\, E \left[\frac{t_w}{a_{max}}\right]^2 \quad \text{(D.7)}$$

a_{max} should be taken as the greater of a_1 and a_2.

For sinusoidally corrugated webs $\tau_{cr,\ell}$ may be obtained from

$$\tau_{cr,l} = \left(5{,}34 + \frac{a_3\, s}{h_w t_w}\right)\frac{\pi^2 E}{12(1-\nu^2)}\left(\frac{t_w}{s}\right)^2 \quad \text{(D.8)}$$

where w length of one half wave, see Figure D.1,

s unfolded length of one half wave, see Figure D.1.

(3) The reduction factor $\chi_{c,g}$ for global buckling should be taken as

$$\chi_{c,g} = \frac{1{,}5}{0{,}5 + \bar{\lambda}_{c,g}^2} \leq 1{,}0 \quad \text{(D.9)}$$

where $\bar{\lambda}_{c,g} = \sqrt{\dfrac{f_y}{\tau_{cr,g}\sqrt{3}}}$ (D.10)

$$\tau_{cr,g} = \frac{32{,}4}{t_w\, h_w^2}\sqrt[4]{D_x\, D_z^3} \quad \text{(D.11)}$$

$$D_x = \frac{E\, t^3}{12(1-\nu^2)}\frac{w}{s}$$

$$D_z = \frac{E\, I_z}{w}$$

I_z second moment of area of one corrugation of length w, see Figure D.1

NOTE 1 s and I_z are related to the actual shape of the corrugation.

NOTE 2 Equation (D.11) is valid for plates that are assumed to be hinged at the edges.

D.2.3 Requirements for end stiffeners

(1) Bearing stiffeners should be designed according to section 9.

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13 Annex D to EN 1993-1-5 – Plate girders with corrugated webs

Bernt Johansson, Division of Steel Structures, Luleå University of Technology

13.1 Background

This section will give background and justification of the design rules for girders with corrugated webs. The rules have been developed during the drafting of EN 1993-1-5 and the background has not been published. For this reason this section will be quite detailed giving the reasoning behind the choice of design rules for shear resistance.

Girders with corrugated webs are marketed as a product from specialised fabricators or as one-off structures. One example of the former is Ranabalken, which has been on the Swedish market for about 40 years [1]. Its main use is as roof girder. It has a web geometry that is fixed because of the production restraints. A vertical section through the web is shown in Figure 13.1. The thickness of the web is minimum 2 mm, which is governed by the welding procedure. The welding is single sided, which is important for the competitiveness. The maximum depth is 3 m.

In Austria the company Zeman & Co is producing similar beams named Sin-beam but with sinusoidally corrugated webs with the web geometry also shown in Figure 13.1. The web depth is limited to 1500 mm and the web thickness is from 2 to 3 mm. The web has single sided welds.

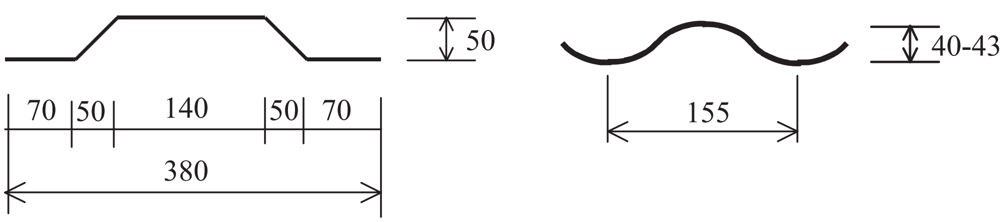


Figure 13.1: Geometry of web plate of Ranabalken, Sweden and Sin-beam, Austria

Corrugated webs have been used for bridges in several countries, including France, Germany and Japan. In France at least three composite bridges have been built of which one was doubly composite with box section. The corrugated steel web was provided with very small flanges, just enough for fixing the shear connectors. The concrete slabs were post-tensioned and when it is important that the steel flanges do not offer too much resistance to the imposed strains. A similar but larger bridge has been built at Altwipfergrund in Germany. It is a three span bridge built by cantilevering with a central span of 115 m and the depth varies from 2,8 m in the span to 6 m at the intermediate supports. The use of single sided welds is not recommended for bridges as it would cause problems with the corrosion protection and the fatigue resistance is not documented.

13.2 Bending moment resistance

EN 1993-1-5, D.2.1

As the web is corrugated it has no ability to sustain longitudinal stresses. The conventional assumption is to ignore its contribution to the bending moment resistance. This is the basis for the rules in D.2.1. For a simply supported girder supporting a uniformly distributed load the bending resistance is simply the smallest axial resistances of the flanges times the distance between the centroids of the flanges. This axial resistance may be influenced by lateral torsional buckling if the compression flange is not braced closely enough. Reference is given to the rules in 6.3 of EN 1993-1-1. There may be a positive influence of the corrugated web on the lateral bucking resistance compared to a flat web as the corrugation gives the web a substantial transverse bending stiffness. This should reduce the influence of cross sectional distortion but this influence has not been studied in detail and there is no basis for giving rules. There is also an increase in warping stiffness that may be utilized.

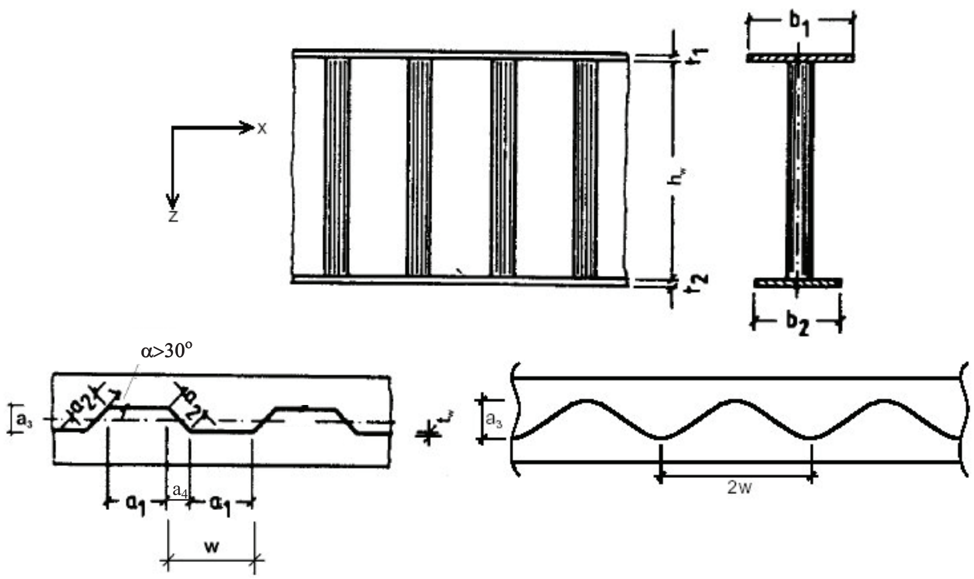
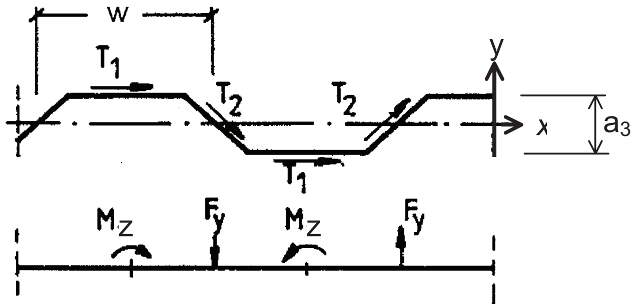


Figure 13.2: Geometry and notations for girders with corrugated webs

If there is a substantial shear force in the cross section of maximum bending moment there may be an influence of the flange axial resistance from lateral bending. Rules for this have been included in the German design rules [2]. A model for calculating these secondary bending moments is shown in Figure 13.3. The shear flow in the web will be constant V/h_w and its effect can be modelled as shown in the lower part of Figure 13.3. The maximum transverse bending moment $M_{z,max}$ occurs where the inclined part of the web intersects the centreline of the flange. It becomes:

$$M_{z,\max} = \frac{Va_3}{4h_w}(2a_1 + a_4) \qquad (13.1)$$

where V is the coexisting shear force and other notations are according to Figure 13.2.



$$F_y = \frac{V}{h_w} a_3$$

$$M_z = \frac{V}{h_w} a_1 \frac{a_3}{2}$$

Figure 13.3: Action model for calculating secondary lateral bending moments in a flange caused by a corrugated web

In [2] the reduction of the bending resistance is expressed by the factor:

$$f_T = 1 - 0,4\sqrt{\frac{6M_{z,\max}\gamma_{M0}}{f_{yf} b_f^2 t_f}} \quad (13.2)$$

This reduction is not large and actually it has not been considered in the Austrian and Swedish design rules. From a theoretical point of view these bending moments are required for reasons of equilibrium. However, it is questionable how important they actually are in real life. They have been included just as a precaution but for sinusoidially corrugated webs the factor is put to 1,0.

In case yielding of the flange governs the bending resistance becomes:

$$M_{Rd} = \frac{f_{yf} f_T b_f t_f}{\gamma_{M0}}\left(h_w + \frac{t_1 + t_2}{2}\right) \quad (13.3)$$

where $b_f t_f$ should be taken as the smaller of $b_1 t_1$ and $b_2 t_2$.

Local flange buckling is of importance for the bending resistance. It will obviously be influenced by the geometry of the web. The question is to define the flange outstand c to be used for calculating the slenderness. There is little information on this question in the literature. One of few published studies is by Johnson & Cafolla [3] who suggested that the average outstand could be used if: EN 1993-1-5, D.2.1(2)

$$\frac{(a_1 + a_4)a_3}{(a_1 + 2a_4)b_1} < 0,14 \quad (13.4)$$

where b_1 is the width of the compression flange and other notations are according to Figure 13.2. It is not stated what to do if this criterion is not fulfilled but presumably the idea is to use the larger outstand. The average outstand was defined as the average of the smaller and the larger outstand each calculated from free edge to the toe of the weld.

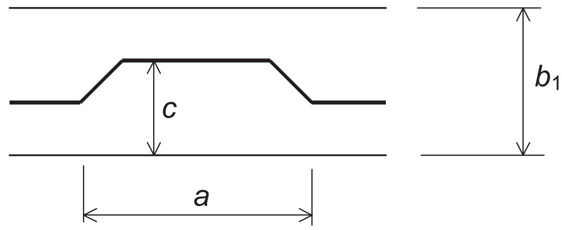


Figure 13.4: Notations for flange geometry

The design rules for Ranabalken states that the outstand should be taken as half the flange width minus 30 mm. This is actually smaller than the smallest outstand, which seems quite optimistic. The corresponding rule for the Sin-beam is half the flange width minus 11 mm.

The flange buckling may in general take place in two different modes. One possibility is a plate type buckling of the larger outstand and another is a torsional buckling where the flange rotates around the centreline of the web. General rules without restrictions on the geometry have to consider both possibilities. The first mode may be relevant for a long corrugation in combination with a narrow flange for which the larger outstand will govern the buckling. However, the flange will be supported by the inclined parts of the web. Assuming an equivalent rectangular plate supported along three edges a safe approximation of the relevant length should be $a = a_1 + 2a_4$, see Figure 13.2 and Figure 13.4. The buckling coefficient of such a plate assuming conservatively a hinged support along the web is approximately [4]:

$$k_\sigma = 0{,}43 + (c/a)^2 \qquad (13.5)$$

with:

c = largest outstand from weld to free edge

$a = a_1 + 2a_4$

For a geometry with small corrugations compared to the flange width the flange will buckle in a mode of rotation around the centreline of the web. Then c is taken to 0,5b. A corrugated web will however give a stronger restraint than a flat web. The buckling coefficient ranges from 0,43 for simple support to 1,3 for fixed. A solution for elastic rotational restraint is given in [4] but it is not easy to use. A simplification in form of a reasonably conservative value is instead suggested, which is also used in [2]:

$$k_\sigma = 0{,}60 \qquad (13.6)$$

The rules for flange buckling in 4.4 (1) and (2) of EN 1993-1-5 are used with the buckling coefficients given above together with the relevant outstand c. In general, both (13.5) and (13.6) have to be checked and the most unfavourable case governs.

13.3 Shear resistance

EN 1993-1-5, D.2.2

13.3.1 Introduction

The shear resistance of corrugated webs has attracted interest from many researcher. Accordingly, there are several proposals for the shear resistance e. g. Leiva [5], Lindner [6], Höglund [7] and Johnson & Cafolla [8]. These will be compared with 70 test results presented in Table 13.1. The formulae for the shear resistance actually used in EN 1993-1-5 were developed during the evaluation. This work was done in close co-operation with Professor Torsten Höglund of the Royal Institute of Technology, Stockholm. He was in charge of the corresponding rules in EN 1999-1-1, which are now harmonized with EN 1993-1-5.

Notations for the corrugated web are shown in Figure 13.2. For the sinusoidally corrugated web the measures a_3 and $2w$ are relevant and the developed length of one full wave is denoted $2s$. For the trapezoidal web the following relations and definitions apply.

$a_2 = a_3/\sin\alpha$

$a_4 = a_3\cot\alpha$

$w = a_1 + a_4$

$s = a_1 + a_2$

t_w = thickness of web

h_w = depth of web

$a_{max} = \max(a_1, a_2)$

There are two shear buckling modes; one local governed by the largest flat panel and one global involving one or more corrugations. The critical stress for local buckling is taken as that for a long plate, which can be written as:

$$\tau_{cr,\ell} = 4{,}83\, E\left[\frac{t_w}{a_{max}}\right]^2 \qquad (13.7)$$

For a sinusoidally corrugated web the local buckling is less likely to occur. A formula for critical shear stress for local buckling of webs with dimension as given in Figure 13.1 can be found in [19] and reads:

$$\tau_{cr,l} = \left(5{,}34 + \frac{a_3 s}{h_w t_w}\right)\frac{\pi^2 E}{12(1-\nu^2)}\left(\frac{t_w}{s}\right)^2 \qquad (13.8)$$

This formula was developed for the type of corrugation used in an Austrian girder but it has turned out that the formula is not general enough and the formula may give large errors if the dimensions are different to those given in Figure 13.1. For this reason sinusoidially corrugated webs have to be designed by testing with regard to local shear buckling where dimensions other than those given in Figure 13.1 are used. There is also a possibility to calculate the critical shear stresses for local buckling with FEM and to use it in the design rules given here.

The critical stress for global buckling is given by [9]:

$$\tau_{cr,g} = \frac{32{,}4}{t_w\, h_w^2}\sqrt[4]{D_x\, D_z^3} \qquad (13.9)$$

where:

$$D_x = \frac{Et_w^3}{12(1-\nu^2)} \frac{w}{s} = \frac{Et_w^3}{12(1-\nu^2)} \frac{a_1 + a_4}{a_1 + a_2} \tag{13.10}$$

$$D_z = \frac{EI_z}{w} = \frac{Et_w a_3^2}{12} \frac{3a_1 + a_2}{a_1 + a_4} \tag{13.11}$$

The first versions of the formulae (13.10) and (13.11) are relevant for sinusoidally corrugated webs where I_z is the second moment of area of one half wave. The second versions are relevant for trapezoidally corrugated webs.

Both critical stresses are valid for simply supported long plates. The global buckling stress is derived from orthotropic plate theory, see e. g. [9]. Some authors have defined D_x without the factor $(1-\nu^2)$ in the denominator. It is theoretically more correct to include it as in (13.10). In [9] there is also a solution for restrained rotation along the edge. For fully clamped edges the coefficient 32,4 in (13.9) increases to 60,4. This has been used for evaluating tests e. g. in [5] but it is hard to believe that this corresponds to the actual conditions at tests. The flanges are not likely to be rigid enough to provide a rotational restraint for such a stiff plate as a corrugated web. In this evaluation (13.9) will be used throughout.

Table 13.1: Data for test girders and test results (The shading shows the governing model and V_{R1} and V_{R2} are according to the EN 1993-1-5 as described in 13.3.6)

Test			h_w	t_w	f_{yw}	α	a_1	a_3	V_u	χ_u	λ_1	λ_2	V_u/V_{R1}	V_u/V_{R2}
No	original	ref[9]	mm	mm	MPa		mm	mm	kN					
0	L1A	5	994	1,94	292	45	140	48	280	0,860	0,931	0,558	1,370	0,860
1	L1B	5	994	2,59	335	45	140	48	502	1,007	0,747	0,556	1,442	1,007
2	L2A	5	1445	1,94	282	45	140	50	337	0,737	0,915	0,774	1,164	0,737
3	L2B	5	1445	2,54	317	45	140	50	564	0,839	0,741	0,768	1,197	0,839
4	L3A	5	2005	2,01	280	45	140	48	450	0,690	0,880	1,092	1,068	0,778
5	L3B	5	2005	2,53	300	45	140	48	775	0,881	0,724	1,067	1,244	0,962
6	B1	10	600	2,1	341	45	140	50	208	0,837	0,929	0,347	1,332	0,837
7	B2	10	600	2,62	315	45	140	50	273	0,954	0,716	0,315	1,340	0,954
8	B3	10	600	2,62	317	45	140	50	246	0,854	0,718	0,316	1,202	0,854
9	B4b	10	600	2,11	364	45	140	50	217	0,815	0,956	0,358	1,315	0,815
10	M101	10	600	0,99	189	45	70	15	53	0,817	0,734	0,750	1,160	0,817
11	M102	10	800	0,99	190	45	70	15	79	0,908	0,736	1,003	1,292	0,912
12	M103	10	1000	0,95	213	45	70	15	84	0,718	0,812	1,342	1,069	1,101
13	M104	10	1200	0,99	189	45	70	15	101	0,778	0,734	1,501	1,106	1,428
14	L1	11	1000	2,1	410	30	106	50	380	0,764	0,772	0,616	1,110	0,764
15	L1	11	1000	3	450	30	106	50	610	0,782	0,566	0,590	0,996	0,782
16	L2	11	1498	2	376	30	106	50	600	0,921	0,776	0,894	1,343	0,921
17	L2	11	1498	3	402	30	106	50	905	0,867	0,535	0,836	1,081	0,867
18	1	12	850	2	355	33	102	56	275	0,788	0,731	0,459	1,118	0,788
19	2	12	850	2	349	38	91	56	265	0,773	0,642	0,466	1,036	0,773

[9] ref = bibliographical reference where the test results can be found

No	Test original	ref[9]	h_w mm	t_w mm	f_{yw} MPa	α	a_1 mm	a_3 mm	V_u kN	χ_u	λ_1	λ_2	V_u/V_{R1}	V_u/V_{R2}
20	V1/1	13	298	2,05	298	45	144	102	68	0,646	0,917	0,099	1,021	0,646
21	V1/2	13	298	2,1	283	45	144	102	70	0,684	0,872	0,096	1,054	0,684
22	V1/3	13	298	2	298	45	144	102	81	0,789	0,940	0,100	1,262	0,789
23	V2/3	13	600	3	279	45	144	102	235	0,810	0,606	0,175	1,060	0,810
24	CW3	8	440	3,26	284	45	250	45	171	0,726	0,976	0,218	1,184	0,726
25	CW4	8	440	2,97	222	45	250	45	154	0,918	0,947	0,198	1,475	0,918
26	CW5	8	440	2,97	222	45	250	63	141	0,841	0,947	0,156	1,350	0,841
27	I/5	14	1270	2	331	62	171	24	260	0,535	1,223	1,483	0,987	0,963
28	II/11	14	1270	2	225	62	171	24	220	0,666	0,974	1,267	1,085	0,935
29	121216A	15	305	0,64	676	45	38	25	50	0,656	1,165	0,583	1,177	0,656
30	121221A	15	305	0,63	665	55	42	33	46	0,623	1,298	0,501	1,190	0,623
31	121221B	15	305	0,78	665	55	42	33	73	0,798	1,048	0,475	1,352	0,798
32	121232A	15	305	0,64	665	63	50	51	41	0,546	1,741	0,391	1,255	0,546
33	121232B	15	305	0,78	641	63	50	51	61	0,692	1,403	0,365	1,386	0,692
34	121809A	15	305	0,71	572	50	20	14	63	0,880	0,509	0,829	1,078	0,880
35	121809C	15	305	0,63	669	50	20	14	55	0,740	0,620	0,924	0,978	0,740
36	121832B	15	305	0,92	562	63	50	51	53	0,581	1,113	0,328	1,018	0,581
37	122409A	15	305	0,71	586	50	20	14	58	0,791	0,515	0,839	0,973	0,791
38	122409C	15	305	0,66	621	50	20	14	58	0,803	0,570	0,880	1,026	0,803
39	122421A	15	305	0,68	621	55	42	33	43	0,578	1,162	0,475	1,036	0,578
40	122421B	15	305	0,78	638	55	42	33	61	0,695	1,027	0,466	1,165	0,695
41	122432B	15	305	0,78	634	63	50	51	49	0,562	1,395	0,363	1,122	0,562
42	181209A	15	457	0,56	689	50	20	14	81	0,795	0,708	1,446	1,111	1,373
43	181209C	15	457	0,61	592	50	20	14	89	0,933	0,602	1,312	1,219	1,382
44	181216C	15	457	0,76	679	45	38	25	119	0,873	0,984	0,839	1,430	0,873
45	181221A	15	457	0,61	578	55	42	33	62	0,666	1,250	0,706	1,244	0,666
46	181221B	15	457	0,76	606	55	42	33	98	0,806	1,027	0,684	1,350	0,806
47	181232A	15	457	0,6	552	63	50	51	52	0,594	1,692	0,542	1,340	0,594
48	181232B	15	457	0,75	602	63	50	51	80	0,671	1,414	0,535	1,349	0,671
49	181809A	15	457	0,61	618	50	20	14	82	0,823	0,615	1,341	1,085	1,262
50	181809C	15	457	0,62	559	50	20	14	78	0,852	0,576	1,270	1,093	1,200
51	181816A	15	457	0,63	592	45	38	25	75	0,761	1,108	0,821	1,329	0,761
52	181816C	15	457	0,74	614	45	38	25	96	0,800	0,961	0,803	1,294	0,800
53	181821A	15	457	0,63	552	55	42	33	56	0,610	1,182	0,684	1,104	0,610
54	181821B	15	457	0,74	596	55	42	33	93	0,798	1,046	0,683	1,351	0,798
55	181832A	15	457	0,61	689	63	50	51	53	0,477	1,859	0,603	1,145	0,477
56	181832B	15	457	0,75	580	63	50	51	79	0,687	1,388	0,525	1,368	0,687
57	241209A	15	610	0,62	606	50	20	14	71	0,536	0,599	1,765	0,699	1,292
58	241209C	15	610	0,63	621	50	20	14	79	0,573	0,597	1,780	0,746	1,400
59	241216A	15	610	0,63	592	45	38	25	76	0,578	1,108	1,096	1,009	0,656
60	241216B	15	610	0,79	587	45	38	25	133	0,813	0,880	1,032	1,259	0,848
61	241221A	15	610	0,61	610	55	42	33	77	0,587	1,284	0,968	1,114	0,587
62	241221B	15	610	0,76	639	55	42	33	127	0,742	1,055	0,938	1,261	0,742
63	241232A	15	610	0,62	673	63	50	51	69	0,469	1,808	0,792	1,104	0,469
64	241232B	15	610	0,76	584	63	50	51	101	0,645	1,374	0,701	1,276	0,645

No	Test original	ref[9]	h_w mm	t_w mm	f_{yw} MPa	α	a_1 mm	a_3 mm	V_u kN	χ_u	λ_1	λ_2	V_u/V_{R1}	V_u/V_{R2}
65	Gauche	16	460	2	254	30,5	0	126	139	1,029	1,494	0,121	2,142	1,029
66	Droit	16	550	2	254	30,5	0	126	109	0,675	1,494	0,145	1,405	0,675
67	Sin 1	17	1502	2,1	225	2w=155		40	370	0,902	0,433	1,108	1,046	1,038
68	Sin 2	17	1501	2,1	225	2w=155		40	365	0,890	0,433	1,108	1,032	1,025
69	Sin 3	17	1505	2,1	225	2w=155		40	353	0,859	0,433	1,108	0,996	0,989

Slenderness parameters are defined by:

$$\lambda_i = \sqrt{\frac{f_{yw}}{\tau_{cri}\sqrt{3}}} \qquad (13.12)$$

for i = 1,2,3 there 1 and 2 refers to equations (13.8) and (13.9) and 3 to equation (13.14) below.

Values for the slenderness parameters λ_1 and λ_2 for the test girders are given in Table 13.1. The characteristic shear resistance is represented by:

$$V_R = \chi \frac{f_{yw}}{\sqrt{3}} h_w t_w \qquad (13.13)$$

where χ is the minimum of the reduction values χ_i determined for λ_1 and λ_2.

The ultimate shear resistance V_u in the tests can be transformed to the non-dimensional parameter χ_u by equation (13.13) and it is also given in Table 13.1.

The parameters defined above are general and will be used throughout the analysis. The features of the different models will now be described briefly and evaluated.

13.3.2 Model according to Leiva [5]

Leiva does not fully develop a design model but his main concern is the interaction between local and global buckling, which is based on observations from tests. His idea is to consider this interaction by defining a combined critical stress τ_{cr3} as:

$$\frac{1}{\tau^n_{cr3}} = \frac{1}{\tau^n_{cr1}} + \frac{1}{\tau^n_{cr2}} \qquad (13.14)$$

Leiva discussed only in case n=1 but the equation has been written more general for later use. He also considered yielding as a limit for the component critical stresses in an attempt to make a design formula. The idea of Leiva will not be evaluated but it will form the basis for a model that will be presented later called "Combined model".

13.3.3 Model according to Lindner [6]

Lindner made an evaluation of test results 0 to 23 in Table 13.1. He discussed different options for taking the interaction between local and global buckling into account, including using (13.14) with n=2. His conclusions were however that the interaction could be taken into account implicitly by correcting λ_2. Lindner's model has been introduced in German recommendations [2]. The reduction factor for the resistance:

$$\chi_{i,L} = \frac{0.588}{\lambda_i} \qquad (13.15)$$

is used for both local and global buckling. λ_1 is as defined in (13.12) but λ_2 is changed according to:

$$\lambda_2 = \sqrt{\frac{2 f_y}{\tau_{cr2}\sqrt{3}}} \text{ if } 0.5 < \tau_{cr1}/\tau_{cr2} < 2 \qquad (13.16)$$

The model has been evaluated with results shown in Figure 13.5 and in Table 13.2 where χ_L is the smallest of χ_{1L} and χ_{2L} according to (13.15). The right hand diagram in Figure 13.5 shows that the model has a slight bias with respect to λ_2. It is an under-prediction of the resistance that increases with the slenderness for global buckling. Further the model includes discontinuities in the prediction because of the stepwise correction in (13.15).

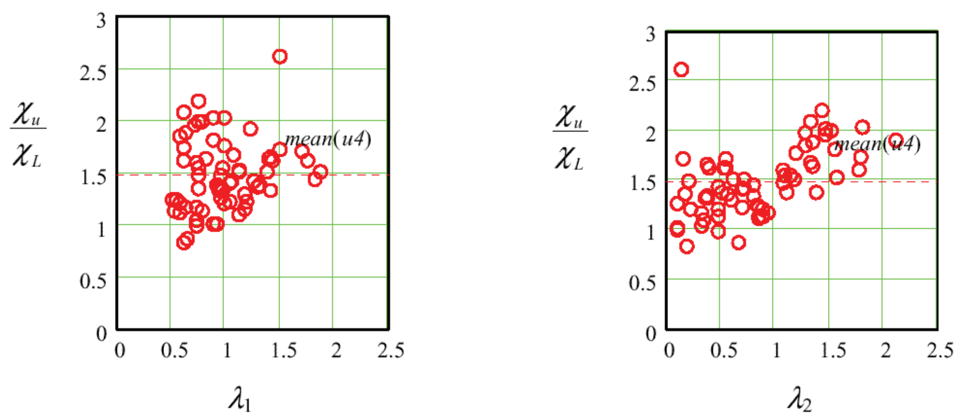


Figure 13.5: Test over prediction as function of λ_1 and λ_2 according to Lindner's model

13.3.4 Model according to Johnson [8]

The model according to Johnson involves three separate checks; one for local buckling, one for global buckling and one for combined local and global buckling. The check for local buckling is done with the post-buckling resistance predicted by:

$$\chi_{1J} = \frac{0,84}{\lambda_1} < 1,0 \qquad (13.17)$$

For the global buckling the critical stress (13.9) is used but with a coefficient 36 instead of 32,4 and without $(1-\nu^2)$ in the denominator of D_x which gives more or less the same results. The design strength is taken as 0,5 times the critical stress, which includes a partial safety factor of 1,1. Considering theses differences the characteristic reduction factor becomes:

$$\chi_{2J} = \frac{0{,}61}{\lambda_2^2} \tag{13.18}$$

if λ_2 is defined by (13.12) and (13.9).

Finally, the interaction between local and global buckling is considered with the critical stress τ_{cr3} according to (13.14) with n=1. The resistance is taken as the critical stress with a reduction factor 0,67×1,1, which leads to the reduction factor:

$$\chi_{3J} = \frac{0{,}74}{\lambda_3^2} \tag{13.19}$$

where λ_3 is defined by (13.12) and (13.14) with n=1.

The evaluation is shown in Figure 13.6 and Table 13.2. χ_J is taken as the lowest value from the three separate checks. The right hand diagram depicting the combined check shows a clear bias for under-prediction for high slenderness values, which is caused by the use of reduced critical stresses as design strength. The scatter in the quotient test over prediction shown in Table 13.2 is also fairly high.

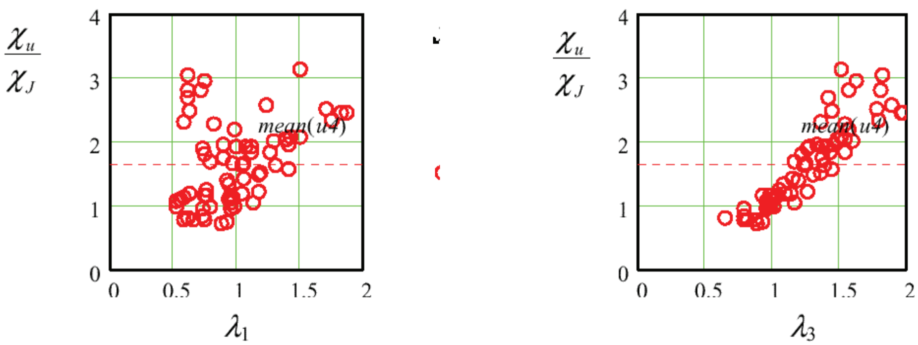


Figure 13.6: Test over prediction as function of λ_1 *and* λ_3 according to Johnson's model

13.3.5 Combined model

The basic idea of this model was to define the resistance by a single reduction factor. A reduced critical stress will be defined by (13.14) in order to take the interaction between local and global buckling into account. This critical stress is used to calculate the slenderness parameter λ_3 from (13.12). It is used in combination with the strength function:

$$\chi_C = \frac{1.2}{0.9 + \lambda_3} < 1{,}0 \tag{13.20}$$

The results for n=2 are shown in Table 13.2 and in Figure 13.7. Also n=4 has been checked and the result is quite similar considering the statistical parameters. Both alternatives represent a quite weak interaction and the interaction becomes weaker the higher value of n is used. It can be seen that this model improves the prediction. However, the model is symmetrical in the influence of local and global buckling. It could be expected on theoretical grounds that the post-critical resistance is more pronounced for local buckling than for global. In the latter case it is questionable if there is any at all. On the other hand the influence of imperfections in the range of medium slenderness can be expected to be smaller than for local buckling. This became clear when the tests with sinusoidialy corrugated webs were included in the comparisons, which was done quite late in the work. This reasoning led to the model described in the next section.

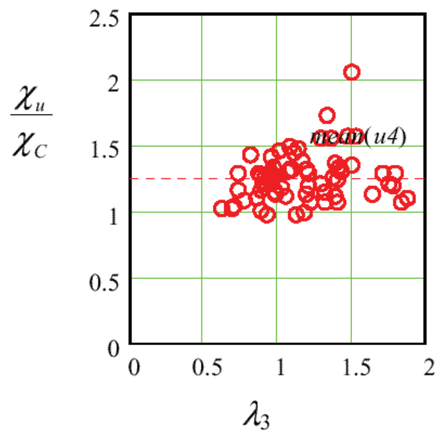


Figure 13.7: Test over prediction as function of λ_3 according to model Combined check, *n*=2

13.3.6 Model according to EN 1993-1-5

The model is based on the one proposed by Höglund [7]. It has two separate checks, one for local and one for global buckling. It has been modified in [18] and further modification has been done here as will be discussed below. The reduction factors for local and global buckling, respectively, is given by:

$$\chi_{1,EN} = \frac{1.15}{0.9 + \lambda_1} < 1.0 \tag{13.21}$$

$$\chi_{2,EN} = \frac{1.5}{0.5 + \lambda_2^2} \leq 1.0 \tag{13.22}$$

The reasoning behind the two checks is that the local buckling is expected to show a post-critical strength, which should not be present in the global buckling. This is reflected by λ_1 appearing linear and λ_2 is squared in the reduction factor. In [18] the reduction factor for local buckling has no plateau but the global buckling has the same reduction factor as (13.17). There is however one more difference. The restraint from the flanges to the global buckling is included in [18] and an increase of the buckling coefficient to 40 is suggested if a certain stiffness criterion is met. The predictions were compared with the test results in Table 13.1 and also with some tests on aluminium girders. The prediction is marginally better than the one using (13.21) and (13.22). The idea of increasing the global buckling coefficient has also been discussed by Leiva and it may very well be true. It has however not been included in the model in EN 1993-1-5 for simplicity and as an additional safety measure. The reduction factors (13.21) and (13.22) are shown in Figure 13.9 together with the Euler curve and the von Karman curve.

There are no test results that make it possible to evaluate the length of the plateau length for local buckling. Equation (13.21) has a plateau until $\lambda_1 = 0.25$, which is very small compared to other buckling problems. For instance the design rules for flat webs give λ = 0.83 for the plateau length with η = 1. This question will remain unsettled until further experiments are available. It is believed that (13.21) is conservative enough.

The evaluation results are found in Figure 13.8 and Table 13.2. The notation χ_{EN} is the minimum of (13.21) and (13.22). The prediction is quite good with all the results between 1 and 1,5, except for test 65, which stick out in all the evaluations.

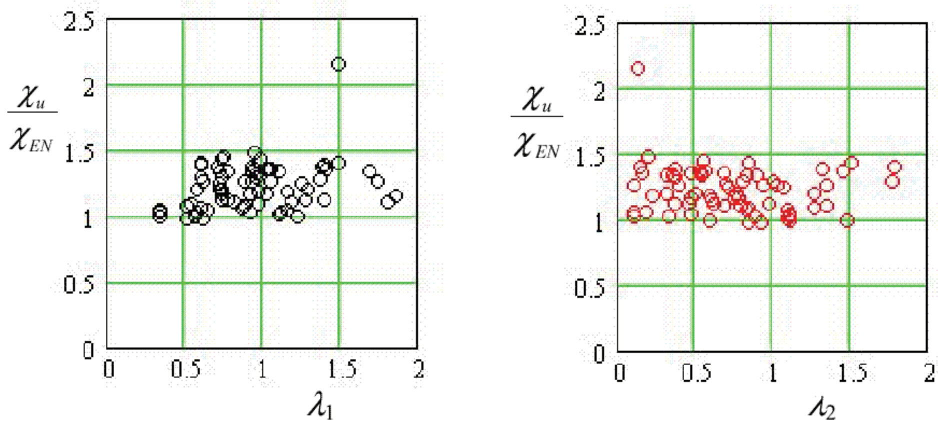


Figure 13.8: Test over prediction according to the model in EN 1993-1-5

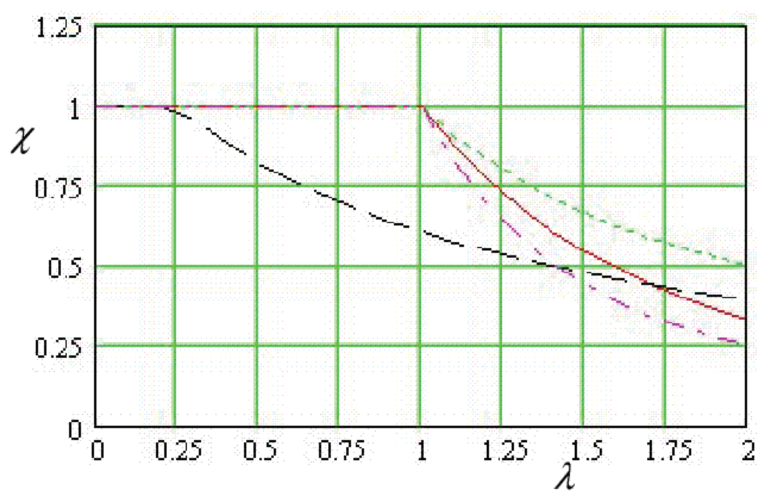


Figure 13.9: Reduction factors according to EN 1993-1-5; global buckling solid and local buckling dashed. As reference the Euler curve 1/λ^2 is shown as dash-dots and the von Karman curve 1/λ as dots

Figure 13.10 shows the test results for which local buckling is supposed to govern and Figure 13.11 there global buckling is supposed to govern. The predictions gives almost the same statistical characteristics, mean 1,22 and 1,23 with coefficient of variation 0,15 and 0,14 for local and global buckling, respectively.

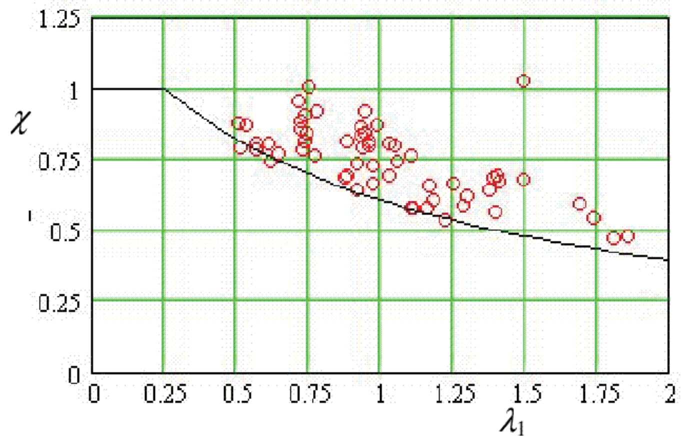


Figure 13.10: Reduction factor for local buckling together with 59 test results where local buckling is supposed to govern

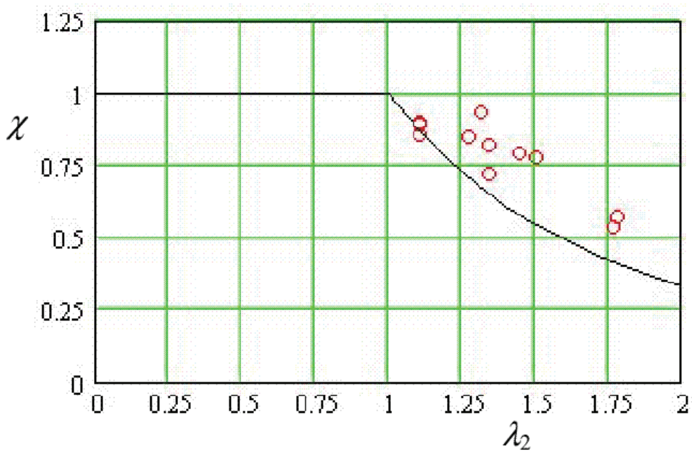


Figure 13.11: Reduction factor for global buckling together with 11 test result where global buckling is supposed to govern

Table 13.2: Evaluation of design models showing mean value, standard deviation and coefficient of variation of the quotient $\chi_u/\chi_{prediction}$

Model	Lindner	Johnson	Combined n=2	EN1993-1-5
Mean	1.48	1.62	1.26	1.22
Stand dev	0.34	0.65	0.19	0.18
Coeff of var	0.23	0.39	0.15	0.15

13.3.7 Discussion

The test data base is quite large and covers a range of parameters for instance:

$190 < f_y < 690$ Mpa

$140 < h_w/t_w < 1200$

$30^o < \alpha < 63^o$

Most of the tests are normal I-girders tested in three or four point bending. The exceptions are test 27 and 28, which were racking tests on container walls with an unsymmetrical corrugation. The report included one more shear test that has been discarded because the web was not continuously welded. Test 65 and 66 had a triangular corrugation (a_1 in Figure 13.2 equal to zero) and the girder had flanges of cold-formed channels. Test 65 showed a very high resistance compared to prediction, which to some extent may have been influenced by the flanges carrying some shear. However, it is not the whole truth as test 66 does not stick out. The tests by Hamilton [15] included four more tests with the remark “support induced failure”, which are not included in Table 13.1.

The normal procedure for dealing with buckling problems is to use the critical stress for defining a slenderness parameter as in (13.12) and to find a reduction factor that depends on this slenderness parameter. In all the models studied here a post critical strength is recognized for the local buckling. It is however less pronounced than for a flat web. This is likely to be so because the folds of the web are less efficient in supporting tension fields than the flanges of a girder with a flat web. One question is how small the angle α between adjacent panels can be made before the fold becomes insufficient as a support for the panels. The smallest angle in the tests is 30^o. This has been taken as lower limit until further evidence is available.

The next question is interaction between the two buckling modes. This has been considered by most of the authors except Höglund. His reasoning is that the interaction, if any, is so weak that two separate checks are sufficient. The evaluation in Table 13.2 supports this opinion as the EN 1993-1-5 model based on Höglund’s ideas, shows the lowest scatter. The suggestion of Lindner to increase the slenderness parameter for global buckling if the critical stresses for local and global buckling are close to each other is hard to justify and it creates an unnatural discontinuity. Using (13.14) for defining a reduced critical stress would give a continuous procedure that gives the highest interaction when the two critical stresses are equal. This seems intuitively reasonable. It will however be symmetrical in τ_{cr1} and τ_{cr2}, which is not likely to be true as indicated in the discussion in 13.3.5. Because of this theoretical objection and that the prediction of the test results is as good with the separate checks this was chosen.

For some low value of the slenderness the shear yield resistance of the web should be reached. The test results do not indicate at which slenderness this will be safely met. From Figure 13.10 it can be seen that the lowest slenderness there local failure was governing is λ_l=0.5. Judging from experiences of other plate buckling phenomena (13.21) will be very safe with λ_l = 0.25 for reaching the yield resistance as discussed in 13.3.6.

The design model presented in EN 1993-1-5 has been shown to be a step forward compared to other existing or possible design models. It is certainly not the final answer to the question of shear resistance of corrugated webs and future research will hopefully improve the model.

13.4 Patch loading

No rules for patch loading resistance are given in EN 1993-1-5. The rules for flat webs may be used but this is in most cases quite conservative, especially if the loaded length is larger than one half corrugation *w*. The patch loading resistance has been studied by several authors [10], [20], [21]. The results have however not been collated and merged into a design model. In [1] the design rule for patch loading includes only a check of the yield resistance. For sinusoidally corrugated webs for the patch loading resistance has been studied in [22] and [23].

13.5 References

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FLANGE BUCKLING BEHAVIOR OF THE H-SHAPED MEMBER WITH SINUSOIDAL WEBS

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Abstract: This paper will present a study for structural behavior of corrugated web members in two aspects. One is to develop a computational model for sectional carrying capacity, and another is trying to find a rational limit of flange width-to-thickness ratios, which is different from H-shaped member with a flat web. Based on the sectional stress distribution obtained from FEM, it is concluded that the flanges will almost carry 100% sectional normal stresses resulting from axial forces and moments and web will almost carry 100% sectional shear force. Based on two different flange buckling modes observed from FE numerical studies in this paper, the flange buckling is also studied and a rational limit of flange width-to-thickness ratio is conducted. Finally the comparison between the results obtained from the FE analysis and the test carried out recently in Tsinghua University are given, and it is shown that both reach a good agreement.

Keywords: *sinusoidal web beams, sectional stress distribution, flange buckling*

1. INTRODUCTION

Corrugated web members, which are composed with flat flanges and corrugated webs through continuous welding, have shown their outstanding advantages, and they were used in civil buildings in the past years. As the corrugated web has a high critical load under shear force, even though very thin web is adopted, the H-shaped member with sinusoidal webs will still result in a significant increment of web height without local buckling. Therefore, their sectional capacity to resist moment will be increased greatly. Meanwhile, the web corrugation can greatly increase the out-of-plane stiffness of webs, which means the members have a higher out-of-plane stiffness to keep their shape unchanged during transporting and hoisting. All of these reasons come to the wide application of corrugated web members in portal frames, tier buildings and bridges, etc. H-shaped members with sinusoidal webs, the most frequently used types, considered to be more aesthetical and resistive to fatigue failure, will be introduced and studied in this paper.

Most of the scholars working on this area have laid their focus on the shear load carrying capacity of web, including Peterson and Cord(1960), Rothwell(1968), Sherman and Fisher(1971), Easley(1975), Libove(1977), Lindner(1988), Elgaaly(1990), Abbas(2006),etc. Some theoretical or semiempirical formulas were given to determine the elastic shear buckling load of the web. According to these formulas, the authors adopt some special configurations and section sizes used above, and the stress distribution on the sections will be studied. A simple approach to calculate the sectional strength of corrugated web members will be present here. Furthermore, the flange stability will be studied by finite element method and a rational limit value of flange width-to-thickness ratio will be conducted.

2. STRESS DISTRIBUTION AND SECTIONAL LOAD-CARRYING CAPACITY

2.1 Finite Element Simulations and Analysis

A finite element model of sinusoidal web member was developed by using the general purpose program ANSYS to investigate sectional stress distribution and load carrying capacity. The sectional model was used to perform an elasto-plastic analysis. Reduced integration thin shell elements were used for the web and flanges. To exclude the effect of global member buckling, a short member, with slenderness less than 5 around the strong axis and 30 around the weak axis, was chosen. As can be noted from Fig. 1, the web configuration is sinusoidal with a half wave length $l=155$mm, wave magnitude $f=20$mm and the web thickness $t_w=2.5$mm. The flanges are both 200mm wide by 10mm thick. The material is considered as elastic-perfectly plastic with initial elastic modulus (E) of 206,000MPa, Poisson's ratio (v) of 0.3, and the yield stress (f_y) of 300MPa. Different boundary conditions and load cases were considered to study the stress distribution.

Compared with the conventional flat web beam, H-shaped sinusoidal web members have shown distinct characteristic in stress distribution. Subjected to axial compression or bending, the sinusoidal web has a negligible longitudinal stress across the web section while the flat thin web will result in a significant stress distribution on the section, as shown in Fig. 2.

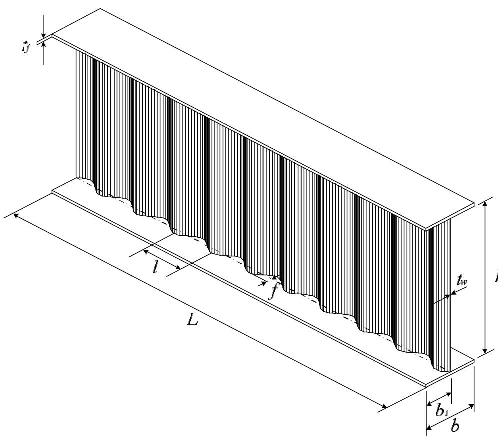


Figure 1 Geometry of sinusoidal web beam

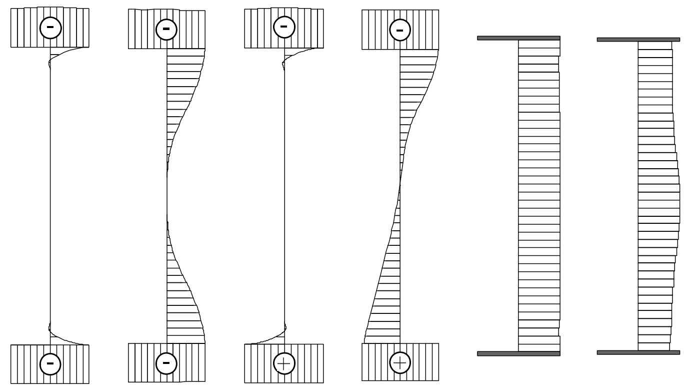


Figure 2 stress distribution of sinusoidal web beam (I) and conventional flat web beam (II)

For the sinusoidal web member subjected to an axial compression or bending, the flanges carry over 99% of the total load, which means the contribution of the corrugated web can be ignored. This is the most important character of stress distribution of corrugated web members. The main reason for that is due to the much smaller longitudinal stiffness of sinusoidal web compared with that of flanges. Subjected to axial forces, the sinusoidal web will produce a considerable moment at the transition part, and the rigid-body motion caused by the rotation of transition part makes the longitudinal deformation develop easily. The sinusoidal web, with the geometry as shown in Fig. 1, takes a longitudinal stiffness of only 1% of the flanges', which can be obtained easily from FE numerical analysis.

For the flat web beam subjected to an axial compression or bending, the load carried by flanges accounts for 75% to 85% of the total, which is higher than the percentage of the flange area, 68%. Although the local buckling of the flat web occurs, it has still played a considerable part to take applied load.

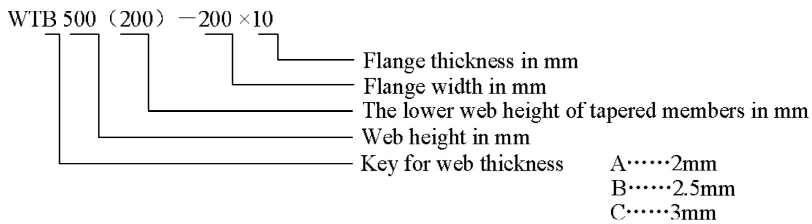
When subjected to shear forces, the shear stress on the sinusoidal web is distributed uniformly, as shown in Fig. 2. e. It is much different from the flat web beam, which is as shown in Fig. 2. f. This distinct difference can be consulted as the second character of stress distribution of sinusoidal web members.

In order to determine stress distribution across the section easily, a computational model is developed as following:

When subjected to axial forces or bending moments, the sinusoidal web member can be treated as a lattice girder, in which only the flanges are available and the web can be ignored; when subjected to shear forces, only the web is available and the shear stress is distributed uniformly.

2.2 Test Investigation

A test program has been carried out, in which 6 series of total 18 tests have been finished in Tsinghua University recently. They include the axial compression tests, the eccentric compression tests, the bending tests and the shearing tests. All of these specimens were fabricated by Zeman GmbH in Austrian and transported to China by air or ship. The materials for the web and flanges are S235JR in accordance with EN 10 025 with a yield strength of 300MPa. The profiling of the web generally avoids the web failure due to loss of its stability before the plastic limit-loading is reached. All of the webs were connected to the flanges on one side of the web with continuous 3mm fillet welds automatically by robot. The designation of specimens followed the following rules:



Since the out-of-plane buckling of sinusoidal web members has been avoided by lateral braces, the sectional ultimate strength only is considered in the analysis by using FE analysis. The applied loads listed in the Table 1 as P_{cal} are obtained directly from the most simplified calculated model mentioned above. Meanwhile, based on FE models with the same parameters of the test specimens, the more accurate results (P_{FE}) will be obtained by using general purpose program ANSYS to perform a nonlinear finite element analysis. All of these results, including test results (P_{test}), are listed below in Table 1, and all comparison reaches a good agreement between them.

Table 1 Comparison between tests, the simplified models and FE analysis

Load case		section	Length/m	P_{test}/kN	P_{FE}/kN	P_{cal}/kN
Axial compression	1-1	WTA500-200×10	2	995[a]	1174	1200
	1-2	WTA500-200×10	5	1132	1139	1200
Eccentric compression	2-1	WTA500-200×10	5	841	809	857
	2-2	WTA500-200×10	5	588	577	600
	2-3	WTA500-200×10	5	372	387	400
3-point bending	3-1	WTC500-200×10	5	165	170	172
	3-2	WTC750-250×12	7	248	255	259
shearing	4-1	WTA500-200×10	1.5	381	343	346
	4-2	WTB500-200×10	1.5	477	431	433
	4-3	WTB 750-250×12	1.5	648	643	649
	4-4	WTC 750-250×12	1.5	777	766	779
	4-5	WTB1000-300×12	2	857	841	866
	4-6	WTC1000-300×12	2	988	1008	1039

[a·] the test loading head failed when the flanges still were kept perfect

As depicted in the simplified model, subjected to bending, the flexural modulus EI_b of H-shaped members with sinusoidal webs can be calculated through assuming flanges to be the only effective parts. However, it must be noted that the shear stiffness of the sinusoidal web is not very high due to very thin web, therefore the effect of shearing deformation must be taken into consideration. The deflection of beam includes two parts: one deformation (Δ_b) caused by bending effects and another deformation (Δ_s) caused by shearing effects. A total elastic stiffness K_0 based on a simplified calculation model reflecting both bending effect and shearing effect could be expressed by the applied load divided

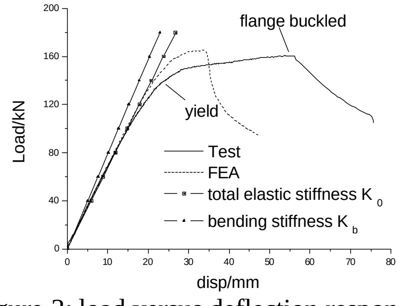


Figure 3: load versus deflection response.

by the total deformation value defined by $\Delta_b+\Delta_s$. The detail derivation of K_0 is found in the reference [Driver(2006)].

The applied loads versus deflection curves are shown in Fig.3 where both the test results and the FEA results are included. The total elastic stiffness K_0 and bending stiffness K_b are depicted in Fig.3 as slopes, too. The total elastic stiffness resulting from test and FEA results agree very well with K_0 and varies a lot from bending stiffness K_b. This means that the shearing deformation could not be ignored even for long members when estimating beam deflection. The test setups and failure modes are as shown in Figure 4.

(a) axial compression test

(b) eccentric compression test

(c) bending test

(d) shearing test

Figure 4 test setups

2.3 Summary of Sectional Load Carrying Capacity

Many theoretical and experimental works have been done on the sectional load carrying capacity of H-shaped sinusoidal web members. The computational model proposed above is proved to be rational. Ostensibly, ignoring the web contribution to normal stress makes direct load carrying capacity of sinusoidal web beams lower than conventional flat web beams in the case of the same section sizes, but the benefit is that the sinusoidal web can make the section profile more efficient for carrying moments, namely by increasing web height even though using less web thickness. Although the theoretical comparison of sectional load carrying capacity in the case of the same section sizes between flat web and sinusoidal web can’t show the advantages of sinusoidal web members directly, the facts that such thin sinusoidal web beams can be transported and erected safely, and loaded to failure due to flanges yielding instead of web failure, can strongly prove them to be economical and efficient members.

3. STABILITY OF FLANGE

In conventional flat web beams, the flange stability can be assessed by assuming the flange to be plates simply supported on three sides. For a sinusoidal web beams, the boundary condition can not be simplified in this way. Many research works have been down on this topic these years. In BS EN 1993-1-5:2006, for trapezoidal web girders, a simple approach is proposed to determine the effective area of flange, which regards the buckling factor as the larger of 0.6 and $0.43+(b/a)^2$, where b is the maximum width of the outstand from the toe of the weld to the free edge and a is the distance between two adjacent peaks of corrugation. This approach certainly considers the flange stability in sinusoidal web girders to be much better than conventional flat web girders. However, Johnson (1997) has found that the critical load of flanges in trapezoidal web members may be lower than flat web member, and a function R is proposed to judge whether it is conservative to use the average outstand (the same with flat web members) to determine the critical loads.

All of these works mentioned above are based on the trapezoidal corrugated web members, and the obtained results can not be proved to be suitable for sinusoidal web beams. In this paper a simple model to investigate flange stability of sinusoidal web beams will be proposed and some suggestion about the maximum flange width-to-thickness ratio will be given.

3.1 Simplified Computational Model for Flange Buckling

Although the stiffness of sinusoidal web is neglectable in the action of longitudinal stress, the web can offer a strong support to flanges in the web depth direction, the flange can be treated as a plate simply supported on two loaded sides, only constrained at the web-flange joint in out-of-plane direction. This simplified computational model is depicted as follow in Fig. 5.

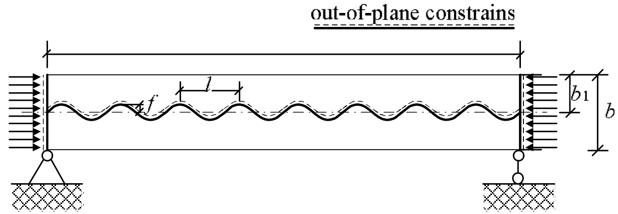
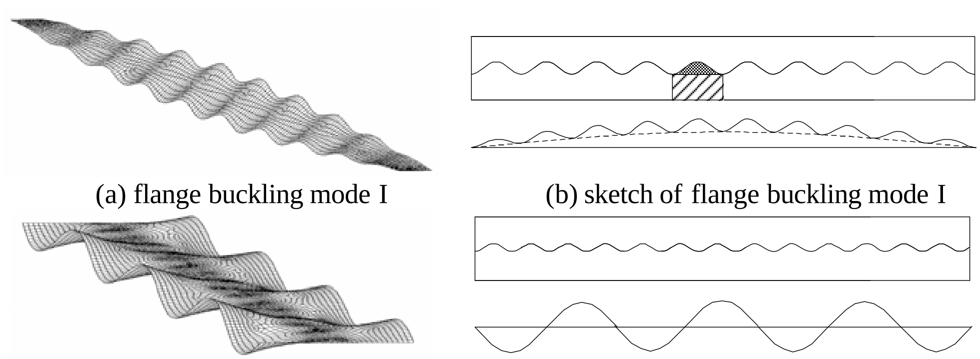


Figure 5: the simplified computational model for flange buckling

Two geometric coefficients are defined to describe the web profile, that is a coefficient of web amplitude $\alpha=f/b_1$, and other coefficient of web wavelength $\beta=l/b_1$. The general purpose program ANSYS is used to perform a parameter study of the critical load versus α, β and width-to-thickness ratio b_1/t.

3.2 Critical Loads of Simplified Flange Model

Many numerical results reveal that whatever the web profile is, the critical loads decrease proportionally to the square of b_1/t. Denoting the critical load of a plate simply supported on three sides as $\sigma_{cr,1}$, and the critical load of a plate supported by the corrugated web shown in Fig. 5, as σ_{cr}, the normalized critical loads $\gamma_{cr}=\sigma_{cr}/\sigma_{cr,1}$ almost hardly change when b_1/t varies alone. Because the influences of web profile and the influence b_1/t to flange buckling are independent, so the effect of b_1/t can be excluded when the influence of the web profile to flange buckling is only considered. This paper attempt to develop the relationship between α, β and σ_{cr} , assuming b_1/t always a constant.



(a) flange buckling mode I (b) sketch of flange buckling mode I

(c) flange buckling mode II (d) sketch of flange buckling mode II

Figure 6 Two buckling modes of flanges

Two different buckling modes are observed as the web corrugation size changed. Buckling mode I is found as shown in Fig. 6(a)(b) and described as: each longitudinal side of the flange deflects towards different directions and the deformed flange rim is like a single half-wave superimposing several small waves, which is dependant on the web corrugation size. Buckling mode II as shown in Fig. 6(c)(d) also may occur and it is similar to the buckling mode of a plate longitudinally clamped on one side. The deformed flange rim is a multi-wave profiling, generally not necessarily the same as the web corrugation wave shape.

It can be noted that for buckling mode I, the critical load decreases when the wave length of corrugation increases, regardless of the amplitude of corrugation or the whole length of the flange. The flange can be treated as a plate supported at the wave crests. The out-of-plane constrains between two adjacent wave crests could not efficiently prevent the trend of a sinusoidal shape plate from buckling. It is to mean that, as the amplitude of corrugation increases, the flange plate loses the constrain provided by half a sinusoidal web at the other point of corrugation except two adjacent wave crest points. The flange buckles as a plate clamped at two wave crest points and free at other points, and its critical load could be calculated as:

$$\sigma_{cr} = \frac{\pi^2 EI_f}{(0.5l)^2 A_f} = \frac{\pi^2 E}{3\beta^2}(t/b_1)^2 \tag{1}$$

In which EI_f is the out-of-plane bending stiffness of the flange plate as a plate-column and A_f is the area of flange.

The equation (1) is compared with the FE numerical results when α=0.5, as shown in Fig. 7. When buckling mode I occurs, the results from equation (1) are quite close to the FE numerical results and a little lower. Therefore, the equation (1) could be able to evaluate the critical load of buckling mode I.

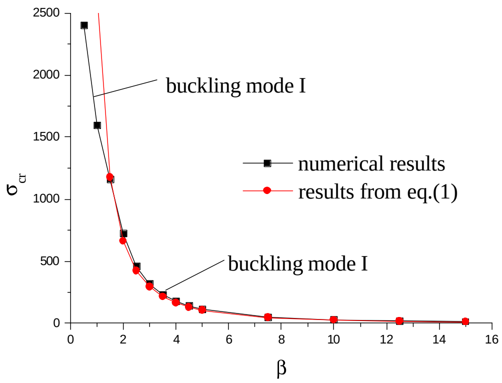


Figure 7 comparison between Equation (1) and FE numerical results

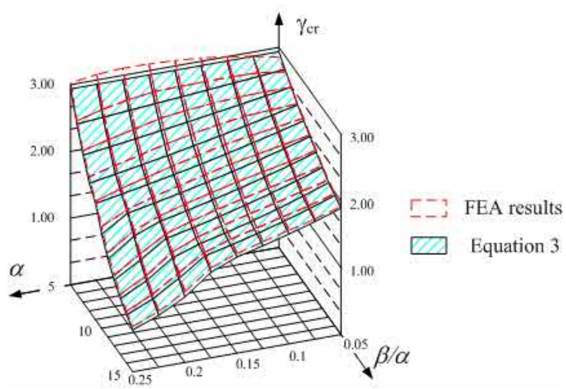


Figure 8 comparison between Equation (3) and FE numerical results

For buckling mode II, the flange could be equivalent to a plate supported at flange-web jointing line with a flexible rotational constrain, with the loaded sides simply supported and the other side free. The flexible constrain extent depends on web corrugation size, namely, *l/f*. The larger *l/f*, the weaker such constrain. On the other hand, comparing the critical loads of flange plates in the case of the same *l/f* and different α, it can be noted that when *l/f* is big enough, the critical load is in inverse proportion to $(1+\alpha)^3$. This is because the chosen calculation width should be taken as the maximum width of the outstand from the toe of the weld to the free edge, namely, $b_1(1+a)$, and the rotational constrain stiffness is a bit weaker. When *l/f* is smaller, the part of the flange width is constrained too firmly to take part in the buckling deformation, so the chosen calculation width should be taken as a smaller number, as $b_1(1+\mu a)$, where μ is a reduction factor to describe the decrease of the chosen calculation width. The value of μ was listed in table 2.

Table 2 value of μ

l/f	5	6	7	8	9	11	• 13
μ	0	1/6	1/3	1/2	0.6	0.8	1.0

Denoting the critical load of a plate clamped on one side as $\sigma_{cr,2}$, the critical load of buckling mode II is between $\sigma_{cr,1}$ and $\sigma_{cr,2}$, depending on the value of *l/f*. Considering the change of effective flange width, a fitting equation is proposed:

$$\sigma_{cr} = \left[\sigma_{cr,1} + \frac{(\sigma_{cr,2}-\sigma_{cr,1})}{1+c(l/f)^2}\right]/(1+\mu\alpha)^3 = \left[\sigma_{cr,1} + \frac{(\sigma_{cr,2}-\sigma_{cr,1})}{1+c(\beta/\alpha)^2}\right]/(1+\mu\alpha)^3 \tag{2}$$

In which c is a constant of 0.0035.

When the flange buckles, the buckling mode could be either mode I or mode II, depending on which one has a lower corresponding critical load. Finally, the normalized critical load is

$$\gamma_{cr} = \min \begin{cases} \left[1+\dfrac{2.012}{1+c\left(\beta/\alpha\right)^2}\right]/\left(1+\mu\alpha\right)^3 \\ 8.56/\beta^2 \end{cases} \tag{3}$$

The equation (3) is compared with FEA results, as shown in Fig. 8. The differences between them are less than 10% and the equation (3) is a little lower. Equation (3) is available when α<=0.25 and l/f>=5, and it can be used to determine which buckling mode would occur.

3.3 Limit Ratio of Flange Width to Thickness in a Sinusoidal Web Member

As in the simplified computational model as shown in Fig.5 that is only a part of a sinusoidal web member, in reality, the boundary condition of flange is a little different from. First of all, the out-of-plane flexural rigidity of webs could offer flanges some extra rotational constrain. This may cause the flange critical load calculated by using the simplified computational model a little higher. Secondly, the web in the overall model is compressible in the direction of depth. The out-of-plane constrain offered by web is not perfectly rigid, which may cause the critical load a little lower. Finite element models of seven H-shaped members including two flanges and sinusoidal web with different web corrugations, were modeled using thin shell elements. Performing a linear buckling analysis by the program ANSYS, the critical load of these overall models were obtained and compared with the three-side simply supported plates in the case of the same b_1/t, as $\gamma_{cr,o}$. The normalized critical loads of the simplified models as shown in Fig.5, were obtained by FE analysis, denoted as $\gamma_{cr,s}$. All of these results, together with the results from Equation (3), are listed in Table 3. These members are divided into 3 series, designated as A-*(buckling mode I controls), B-* (buckling mode II controls) and C-*(flat web).

Table 3 Comparison between equation (3) and FE numerical results

designation	A-1	A-2	A-3	B-2	B-3	B-4	C-0
α	0.4	0.4	0.2	0.1	0.2	0.2	flat web
β	6	3	3	1.5	1.5	1	
γ_{cr} of equation (3)	0.238	0.951	0.951	1.597	2.109	2.85	1
$\gamma_{cr,s}$	0.256	1.027	1.029	1.652	2.257	3.012	1
$\gamma_{cr,o}$	0.6886	1.32	1.57	1.63	2.09	2.58	0.12*

[grey box]—buckling mode I€ [white box]—buckling mode II€ *the flat web buckled

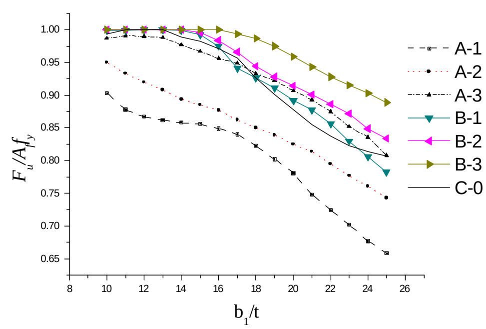


Figure 9 Relationship of ultimate strength ratios versus b_1/t

Furthermore, both geometric and material nonlinear analysis was performed and the ultimate strengths F_u of these overall models were obtained. Setting b_1/t as a variable, the ultimate strength ratio $F_u/A_f f_y$ versus b_1/t curves are depicted in Fig.9. When b_1/t is small, the ultimate strength ratios of series A, whose buckling loads are controlled by buckling mode I, are obviously lower than others. It is recommended to adopt suitable web profiling to avoid buckling mode I, namely, to satisfy equation (4):

$$8.56/\beta^2 > \left[1+\frac{2.012}{1+c\left(\beta/\alpha\right)^2}\right]/\left(1+\mu\alpha\right)^3 \tag{4}$$

In Euro Code EN1993-1-1 and Chinese Code GB50017-2003, the maximum width-to-thickness ratios of flanges in flat web beams are limited to 15ε to ensure the flange stability, in which

$$\varepsilon = \sqrt{235 / f_y} \quad (5)$$

The maximum flange width-to-thickness ratios of sinusoidal web beams could be expressed as

$$b_1 / t(\max) = 15\varepsilon\sqrt{\upsilon} \quad (6)$$

Where υ means the increase factor of b_1/t in sinusoidal web members compared with flat web members, based on the same critical load.

$$\upsilon = \sqrt{\left[1 + \frac{2.012}{1 + c\left(\beta / \alpha\right)^2}\right] / \left(1 + \mu\alpha\right)^3} \quad (7)$$

However, when γ_{cr} of equation (3) is very high, the actual critical load of overall model may be lower than γ_{cr} because of the compressibility of web in the depth direction. A square root is taken to υ to consider a reduction in equation (6). Usually the value of υ is between 1.00~1.75, so the maximum width-to-thickness ratio could be up to 20ε. When a proper web profiling is adopted, the flange stability could be significantly increased due to the effect of the sinusoidal web.

4. CONCLUSION

A computational model for sectional load carrying capacity of a sinusoidal web member was proposed and was proved to be rational by both FE numerical analysis and test investigation. The sectional load carrying capacity and the deflection of beams could be easily obtained through this sectional model. Further more, based on two different flange buckling modes observed from numerical studies, the flange buckling was also studied and a rational limit of width-to-thickness ratios of flange was conducted. The research works are still on going in Tsinghua University and further research conclusions on the overall instability of a sinusoidal web member will be obtained recently.

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SHEAR TESTING OF THE SIN BEAM

FINAL

For

Steelcon Fabrication Inc.

Head Office
62 Progress Court
Brampton, Ontario L6S 5X2

By

Dr. Reinhold M. Schuster, P. Eng.
Distinguished Professor Emeritus
University of Waterloo

President
RM Schuster Structural Engineering

Date: December 4, 2016 **Report No. STC 4-12-16**

INTRODUCTION

The SIN Beam

The SIN Beam is a unique steel structural member with a cold formed steel corrugated steel web element welded to two hot-rolled steel flange plates, resulting in a typical wide flange type section. The only difference being that the web is not a linear equal thickness steel plate but a sinusoidal corrugated cold formed steel section. SIN Beams can be used as flexural members such as roof or floor beams, as compression members such as columns, or as members subjected to combined bending and axial loading such as in moment frames. Shown in Figure 1 is a schematic diagram of the SIN Beam section that is manufactured by Steelcon Fabrication Inc. (Steelcon) in Brampton, Ontario.

Corrugated web steel beams have been researched since the 1960's and have been used in Europe for over 30 years. In fact, Annex D (Steel Plated Structural Elements) of Euro Code EN1993-1-5:2006 [1] contains structural design information for such members. The SIN Beam is made using the same equipment and processes that ZEMAN of Austria has been using in Europe for the past 20 years.

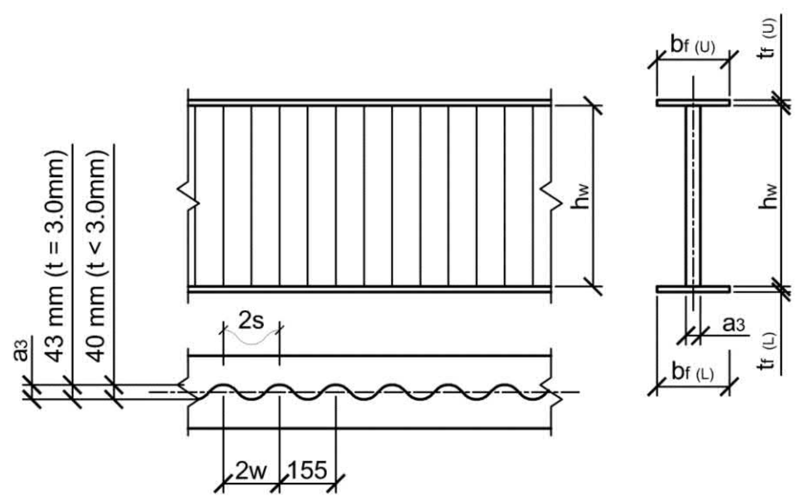

Figure 1 – Schematic Diagram of SIN Beam Section

Governing Canadian Standards

Since the SIN Beam is made of two different steel materials, 1) flanges that are hot-rolled steel plates, CSA S16-14 [2] applies and 2) CSA S136-12 [3] is the Standard that applies for the cold formed steel corrugated web section. In the case of the shear resistance of the SIN Beam, a direct calculation cannot be made based on Section C3.2 of CSA S136-12 [3], however, Section A1.2 does permit the use of a *"Rational Engineering Analysis"* based on appropriate theory and engineering judgement.

Objective

The primary objective of this report was to establish an appropriate rational engineering analysis for the shear resistance of the SIN Beam and to substantiate this analysis with verification testing.

SHEAR RESISTANCE ANALYSIS

Since Euro Code EN1993-1-5:2006 [1] contains a proven analysis for the shear resistance of corrugated steel web members, it was chosen herein as the most appropriate Rational Analysis available in the design Code literature. The nominal shear resistance is computed as follows. As can be observed, the theoretical base of this Equation is von Mises yield theory with a shear buckling coefficient relating to the corrugated web of the member.

$$V_n = \chi_c \frac{1}{\sqrt{3}} F_y A_w; \quad \chi_c = \min(\chi_{c,l}, \chi_{c,g})$$

The value of χ_c is taken as the lesser value of ***Local*** or ***Global*** buckling $\chi_{c,l}$ or $\chi_{c,g}$.

Local Buckling

$$\chi_{c,l} = \frac{1.15}{0.9 + \bar{\lambda}_{c,l}} \leq 1.0$$

$$\bar{\lambda}_{c,l} = \sqrt{\frac{F_y}{\tau_{cr,l}\sqrt{3}}}$$

$$\tau_{cr,l} = \left\{5.34 + \frac{a_3 s}{h_w t_w}\right\} \frac{\pi^2 E}{12(1-\mu^2)} \left(\frac{t_w}{s}\right)^2$$

Global Buckling

$$\chi_{c,g} = \frac{1.5}{0.5 + (\bar{\lambda}_{c,g})^2} \leq 1.0$$

$$\bar{\lambda}_{c,g} = \sqrt{\frac{F_y}{\tau_{cr,g}\sqrt{3}}}$$

$$\tau_{cr,g} = \frac{32.4}{t_w (h_w)^2} \sqrt[4]{D_x (D_z)^3}$$

$$D_x = \frac{E(t_w)^3}{12(1-\mu^2)} \frac{w}{s}$$

$$D_z = \frac{EI_z}{w}$$

Where,
F_y - yield stress of corrugated web
a_3 - amplitude of corrugated web
s - unfolded length of one half corrugation wave
E - modulus of elasticity of corrugated web
μ - poisson's ratio = 0.3
h_w - clear web height of corrugated web
t_w - web thickness of corrugated web
w - length of one half corrugation wave

These buckling coefficients have been developed for steel beams with either trapezoidal or sinusoidal corrugated web configurations. Available research indicates that these coefficients are conservative when applied to steel beams with sinusoidal/corrugated webs such as with the SIN Beam [4], [5]. Extensive testing has been done in Europe to verify the design approach for shear that is contained in Euro Code EN1993-1-5:2006 [1], however, the Steelcon company decided to also carry out such shear tests on its Canadian SIN Beam product.

SHEAR TESTING

General

Steelcon retained "exp Brampton Laboratory" (eBL) to carry out the shear tests of the SIN Beam. Since eBL did not have a structural test frame in their facility with the required capacity, it was decided that Steelcon erect such a test frame in their facility to carry out these tests. All test specimens were fabricated/assembled in the Steelcon plant and actual testing/supervision was performed by the eBL staff. Shown in Figure 2 is a schematic diagram of the shear test set up, where a = 5 ft and b = 4 ft.

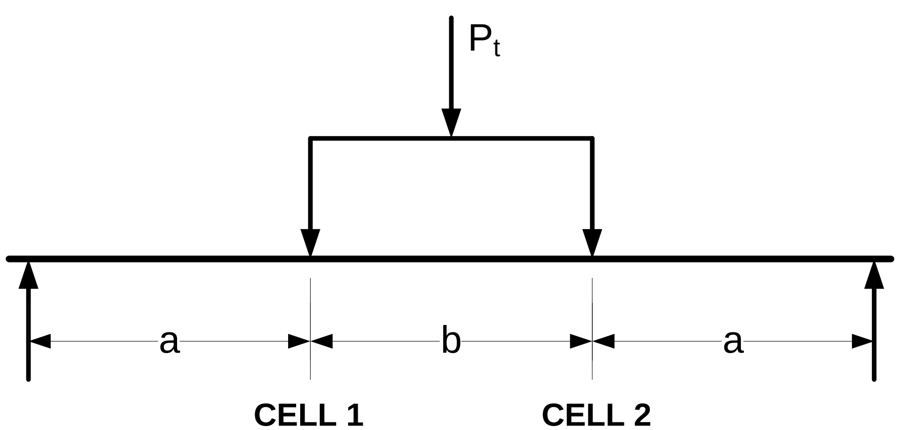

Figure 2 - Schematic Diagram of Shear Test Set up

Three shear tests were carried out in each case for the SIN WTB500/178x16 and the SIN WTA1000/178x10 beams. Two load cells were used to apply the load, CELL 1 and CELL 2. Shown in Figure 3 is a typical shear failure, which I personally witnessed.

Figure 3 – Typical Shear Failure

TEST RESULTS AND COMPARISONS

The test data from Reference 6 is contained in Appendix A of this report. More specifically, Table A1 contains the mechanical properties of the steel. Summarized in Table A2 are the shear test results and the respective calculated values with comparisons. The lesser load of load CELL 1 and load CELL 2 was used as the test shear value, V_t. As can be observed from Table A2, the average shear test ratio, V_t/V_n, in each case is equal to or greater than 1. This indicates that the shear prediction method selected from Reference 1 is an appropriate Rational Analysis method. The calculated nominal shear values are presented in Tables B1 and B2 of Appendix B.

CONCLUSIONS

Based on the information presented herein, the EN1993-1-5:2006 [1] design method satisfies the requirements of CSA S136-12 [3] and can be used for computing the nominal shear resistance of the SIN Beam. The factored shear resistance, V_r, can then be computed as follows

$V_r = \phi_v V_n$,

where $\phi_v = 0.75$ based on Section A1.2(c) [3].

REFERENCES

1) EuroCode EN1993-1-5: 2006 "Design of Steel Structures – Plated Structural Elements", 2006.

2) CANCSA S16-14, "Limit States Design of Steel Structures", Mississauga, Ontario, Canada, Mississauga, Ontario, Canada, October 2012.

3) CSA S136-12, "North American Specification for the Design of Cold-formed Steel Structural Members", Mississauga, Ontario, Canada, October 2012.

4) Hannebauer, D; (2008) "Zur Querschnitts- und Stabtragfähigkeit von Trägern mit profilierten Stegen" - "For cross-sectional and moment carrying capacity of beams with profiled webs", 2008.

5) Pasternak, H; Kubieniec, G (2010) "Plate Girders with Corrugated Webs" Journal of Civil Engineering and Management, 2010.

6) "Witnessing Load Tests on Metal Beams", exp Brampton Laboratory, 1595 Clark Boulevard, Brampton, Ontario, October 19, 2016.

APPENDIX A

Table A1 – Mechanical Properties [6]

Test Type	t (in.)	F_y (ksi)	F_u (ksi)	% Elong.
SIN WTB500/178x16	0.100	56.5	70.9	27.5
SIN WTA1000/178x10	0.0750	60.7	70.9	27.2

Table A2 – Test Data and Comparisons [6]

SPECIMEN	CELL 1 (lb)	CELL 2 (lb)	V_t (lb)	V_t (kip)	V_n (kip)	V_t/V_n	t (in.)	F_y (ksi)
SIN WTB500/178X16								
SB1-A	64,900	69,000	64,900	64.9			0.100	56.5
SB1-B	75,830	71,067	71,067	71.1				
SB1-C	75,972	70,149	70,149	70.1				
			Average	***68.7***	**55.5**	***1.24***		
SIN WTA1000/178X1(								
SB4-A	81,529	77,664	77,664	77.7			0.075	60.7
SB4-B	86,964	82,407	82,407	82.4				
SB4-C	80,974	79,806	79,806	79.8				
			Average	***80.0***	**78.6**	***1.02***		

V_t = Test shear value taken as the lowest of Cell 1 and Cell 2.
V_n = Nominal calculated shear value.

APPENDIX B

Table B1 – SIN WTB500/178x16

```
IMPERIAL UNITS - INPUT DATA AND DETAILED CALCULATIONS - IMPERIAL UNITS
                     * STEELCON SIN BEAM *
----------------------------------------------------------------------
INPUT DATA
HWB= 19.7IN TWB= 0.100IN BFL= 7.01IN TFL= 0.630IN A3= 1.57IN
S= 3.50IN W= 3.05IN FYWB= 56.5KSI EWB= 29500.KSI IZ= 0.0992IN4

CALCULATED VALUES
TCRL= 176.8KSI LAMCL= 0.429 XCL= 0.865 DZ= 959.3K-IN DX= 2.352K-IN
TCRG= 178.5KSI LAMCG= 0.427 XCG= 1.000 XC= 0.865

VN= 55.5KIP   PHIV= 0.75 VR= 41.7KIP
----------------------------------------------------------------------
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Table B2 – SIN WTA1000/178x10

```
IMPERIAL UNITS - INPUT DATA AND DETAILED CALCULATIONS - IMPERIAL UNITS
                     * STEELCON SIN BEAM *
----------------------------------------------------------------------
INPUT DATA
HWB= 39.4IN TWB= 0.075IN BFL= 7.01IN TFL= 0.394IN A3= 1.57IN
S= 3.50IN W= 3.05IN FYWB= 60.7KSI EWB= 31200.KSI IZ= 0.0709IN4

CALCULATED VALUES
TCRL=  93.1KSI LAMCL= 0.613 XCL= 0.760 DZ= 724.7K-IN DX= 1.050K-IN
TCRG=  39.4KSI LAMCG= 0.943 XCG= 1.000 XC= 0.760

VN= 78.6KIP   PHIV= 0.75 VR= 59.0KIP
----------------------------------------------------------------------
DR. SCHUSTER – RM SCHUSTER STRUCTURAL ENGINEERING     December 4, 2016
```