

POCKET COMPANION

INFORMATION AND TABLES FOR
ENGINEERS AND DESIGNERS
AND OTHER DATA
PERTAINING TO
STRUCTURAL
STEEL



CARNEGIE STEEL COMPANY

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Subsidiaries of United  States Steel Corporation

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San Francisco, Calif.

OPEN WEB STEEL JOISTS

In recent years there has been a marked development in steel joists made up of bars or small shapes to form trusses. These joists are adaptable for bearing on masonry walls, steel beams, or girders to suit various conditions. One notable feature is the fact that the open web affords a space for running conduit for electric wiring or pipes for heating or water systems, or even sewer lines in any direction.

The sizes of open web steel joists are standardized in accordance with Simplified Practice Recommendation No. R 94-30 of the Bureau of Standards of the United States Department of Commerce.

The table on page 382 gives the standard designations together with the maximum resisting moment in inch-pounds, the maximum end reaction in pounds and safe load in pounds per foot per joist when designed in accordance with the stresses recommended by the American Institute of Steel Construction.

Tensile stress = 18,000 pounds per square inch.

Compressive stress = $\frac{18,000}{1 + \frac{l^2}{18,000 r^2}}$ with a maximum of 15,000

pounds per square inch, in which l is the unsupported length of the member and r is the corresponding least radius of gyration of the section, both in inches.

Joists longer than those shown in tables are not manufactured. Joists shorter than those shown in tables are made when for any reason it is not practical to use shallow joists for shorter spans. In computing the carrying capacity of shorter joists, the end reaction should be divided by one-half of the span to determine the safe load per linear foot.

The tables show the overall dimensions, maximum and minimum spans, and other data pertaining to the joists manufactured by the leading producers. Detailed data as to the properties of chord sections, etc., may be obtained from the catalogs of each manufacturer.

Steel joists are designed with the assumption that the top chord will be stayed laterally with concrete slabs at least two inches thick.

No material should be used as centering for the top slab which must be stretched across the top chord of joists or which will exert an undue lateral pull on the top chords of the joists during the pouring of concrete.

Steel joists are not intended to act as structural members except as temporary supporting members during construction. With steel joists just as in the case of wood joists, the lateral support of the top deck is an essential element of construction. The performance of a steel joist floor construction can only be determined by applying the top deck and testing with a uniform load. Concrete decks of quick setting cement can be tested at the end of 24 hours.

The spacing center to center of steel joists should not exceed 24 inches for floors, nor 30 inches for roofs.

The end bearing of steel joists should not be less than $2\frac{1}{2}$ inches on steel members, nor less than 4 inches on masonry.

Before being bridged, steel joists cannot be expected to sustain considerable loads, especially moving loads common in building construction. Loading of unstayed joists may easily result in construction accidents. The safety and success of the work depends largely upon the faithful installation of the bridging.

NUMBER OF LINES OF BRIDGING

Span	Number of Lines of Bridging
Up to 14 feet	One row near center.
14 to 21 feet	Two rows at quarter points, approximately.
21 to 32 feet	Three rows.

Each line of bridging should be capable of transmitting 500 pounds from any one joist and distributing it between the two adjacent joists.

The concrete should be placed in strips at right angles to run of joists. Placing in strips parallel to joists results in severe lateral stresses, which are liable to pull joists out of place and lead to construction accidents.

Cutting of web members or parts of chord sections from open web joists must not be permitted under any circumstances.

OPEN WEB STEEL JOISTS

ALLOWABLE TOTAL LOADS IN POUNDS PER LINEAR FOOT

STEEL JOIST INSTITUTE STANDARDS

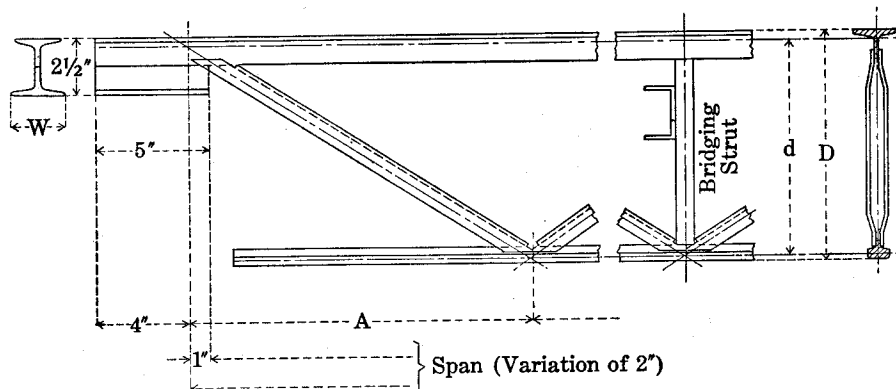
Adopted Aug. 20, 1929. Effective Jan. 1, 1930

American Institute of Steel Construction Unit Stresses

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GABRIEL OPEN WEB STEEL JOISTS

Manufactured by Gabriel Steel Company



Joist Type	Span		Depth		Chord Areas		W	A	End Diagonal	
	Min.	Max.	D	d	Top	Bottom			Gross Area	Net Area
	Ft.-In.	Ft.-In.	In.	In.	In. ²	In. ²			In. ²	In. ²
SJ 81	4-0	16-0	8	7.53	.410	.360	2 $\frac{5}{8}$	1-0	.219	.172
SJ 82	4-0	16-0	8	7.47	.528	.442	3	1-0	.250	.203
SJ 102	9-0	20-0	10	9.47	.528	.442	3	1-3	.250	.203
SJ 103	9-0	20-0	10	9.41	.644	.536	3	1-3	.250	.203
SJ 104	9-0	20-0	10	9.35	.745	.620	4	1-3	.281	.234
SJ 123	13-0	23-0	12	11.41	.644	.536	3	1-4	.281	.234
SJ 124	13-0	24-0	12	11.35	.745	.620	4	1-4	.281	.234
SJ 125	13-0	24-0	12	11.29	.845	.705	4	1-5	.313	.266
SJ 126	13-0	24-0	12	11.23	1.090	.910	4 $\frac{1}{2}$	1-5	.344	.297
SJ 145	17-0	26-0	14	13.29	.845	.705	4	1-5	.313	.266
SJ 146	17-0	28-0	14	13.23	1.090	.910	4 $\frac{1}{2}$	1-5	.344	.297
SJ 147	17-0	28-0	14	13.19	1.290	1.160	4 $\frac{1}{2}$	1-5	.375	.328
SJ 166	21-0	30-0	16	15.23	1.090	.910	4 $\frac{1}{2}$	1-6	.344	.297
SJ 167	21-0	32-0	16	15.19	1.290	1.160	4 $\frac{1}{2}$	1-6	.375	.328

Gabriel Joists are built to the job spans with one inch variation on each end.

Chord Sections as shown in table are combined with specially designed V-shaped diagonals. The slenderness ratio of the diagonals have been reduced to a minimum.

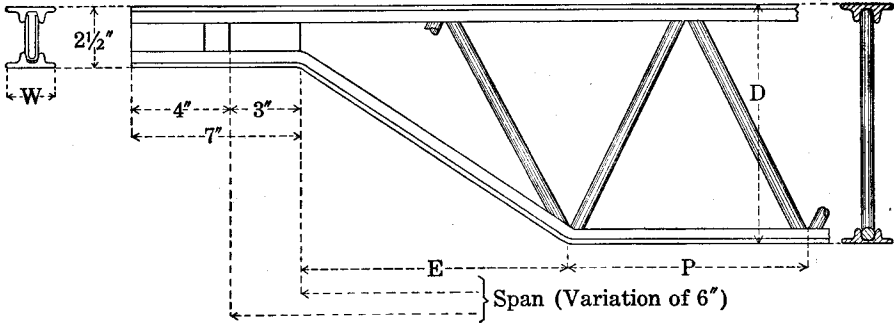
Vertical Bridging Struts are introduced at established panel points to meet the requirements for bridging.

Standard A. S. C. E. Rail Sections, rolled from new billet steel, structural grade, are slit longitudinally to produce the exact top and bottom chord sectional areas required for each case.

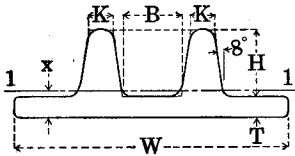
Special Joists are manufactured in all depths for shorter spans than given, when it is desirable to have joists of uniform depth.

HAVEMEYER OPEN WEB STEEL JOISTS

Manufactured by Concrete Steel Company



PROPERTIES OF HAVEMEYER TWIN—TEE SECTIONS



Section Number	Weight per Foot Lbs.	W In.	T In.	H In.	B In.	K In.	Area of Section In. ²	Axis 1-1		
								I In. ⁴	r In.	x In.
1	1.37	1.75	5/32	3/8	7/16	9/64	0.40	0.007	0.13	0.16
2	1.63	1.84	5/32	15/32	1/2	5/32	0.48	0.013	0.16	0.19
3	1.96	1.87	5/32	1/2	1/2	1/4	0.58	0.019	0.18	0.22
4	2.36	2.29	5/32	9/16	9/16	33/128	0.69	0.027	0.20	0.24
5	2.62	2.48	5/32	19/32	9/16	9/32	0.77	0.033	0.21	0.25
6	2.88	2.68	3/16	5/8	5/8	7/32	0.85	0.039	0.21	0.24
7	3.44	2.88	13/64	11/16	5/8	1/4	1.01	0.056	0.24	0.27

Joist Type	Span		D In.	P In.	E		Top Chord Section Number	Bottom Chord Section Number	Diameter of Web	
	Min.	Max.			Min.	Max.			End Members	Interior Members
	Ft.-In.	Ft.-In.			In.	In.			In.	In.
SJ 81	4-0	16-0	8	8	8	11	1	1	7/16	3/8
SJ 82	4-0	16-0	8	8	8	11	2	1	7/16	3/8
SJ 102	4-0	20-0	10	10	11	15	2	1	7/16	3/8
SJ 103	10-0	20-0	10	10	11	15	3	2	7/16	3/8
SJ 104	10-0	20-0	10	10	11	15	4	3	1/2	7/16
SJ 123	4-0	24-0	12	12	12	15	3	2	1/2	7/16
SJ 124	12-0	24-0	12	12	12	15	4	3	1/2	7/16
SJ 125	12-0	24-0	12	12	12	15	6	4	9/16	1/2
SJ 126	12-0	24-0	12	12	12	15	7	6	9/16	1/2
SJ 145	4-0	28-0	14	14	15	21	5	4	9/16	1/2
SJ 146	14-0	28-0	14	14	15	21	7	6	5/8	1/2
SJ 166	4-0	32-0	16	16	17	24	7	6	5/8	9/16

Havemeyer Steel Joists are made in span lengths varying by 6 inches from minimum to maximum as given in table.

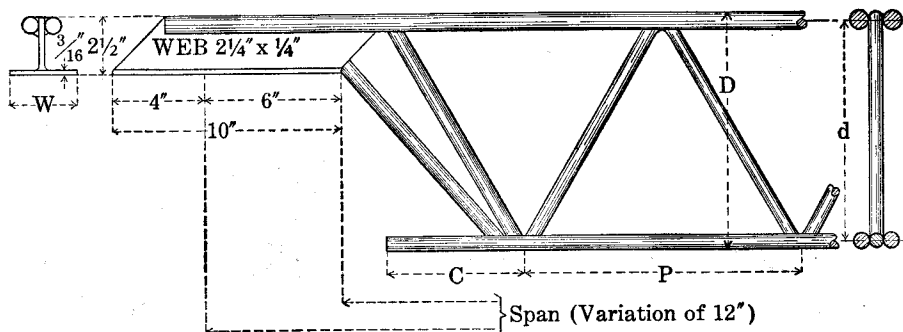
Top and bottom chords consist of special rolled twin-tee sections. Web members are round bars bent into the form of a Warren truss.

Section Numbers for chords and diameters of the web bars for various sizes of joists are shown in lower table. End Filler Sections are 1/2-inch plates bent "U" shape.

Joists are assembled by means of electric welding.

MACOMBER OPEN WEB STEEL JOISTS

Manufactured by the Macomber Steel Company



Joist Type	Span		D	d	Top Chord Dia.	Bottom Chord Dia.	C	P	W	End Web Dia.
	Min.	Max.								
	Ft.-In.	Ft.-In.	In.	In.	In.	In.	In.	In.	In.	In.
SJ 81	4-0	16-0	8.00	7.583	.454	.380	6	12	1.875	.497
SJ 82	10-0	16-0	8.12	7.582	.570	.497	6	12	1.875	.497
SJ 102	12-0	20-0	10.00	9.466	.570	.497	6	12	1.875	.570
SJ 103	15-0	20-0	10.06	9.463	.625	.570	6	12	1.875	.570
SJ 104	16-0	20-0	10.13	9.467	.700	.625	6	12	2.875	.625
SJ 123	15-0	24-0	12.00	11.397	.668	.534	9	12	2.875	.625
SJ 124	18-0	24-0	12.03	11.382	.700	.598	9	12 & 18	2.875	.625
SJ 125	20-0	24-0	12.07	11.368	.740	.668	9	12 & 18	2.875	.740
SJ 126	22-0	24-0	12.14	11.367	.810	.740	9	12 & 18	2.875	.740
SJ 145	19-0	28-0	14.00	13.296	.740	.668	9	12 & 18	2.875	.740
SJ 146	23-0	28-0	14.07	13.295	.810	.740	9	12 & 18	3.875	.740
SJ 147	25-0	28-0	14.15	13.298	.887	.810	9	12 & 18	3.875	.810
SJ 166	25-0	32-0	16.00	15.225	.810	.740	9	12 & 18	3.875	.810
SJ 167	27-0	32-0	16.08	15.228	.887	.810	9	12 & 18	3.875	.810

Macomber Joists are manufactured for each foot in length from minimum to maximum span given above. Length of joist is 1'-8" greater than minimum and 8" more than maximum span. All joists are designed to have a variation of 1'-0" and maintain minimum end bearing of 4".

Joists less than minimum are made to order.

Chord Members consist of two round bars; webs, one round bar.

The diameters of the interior web members vary in size in the same truss.

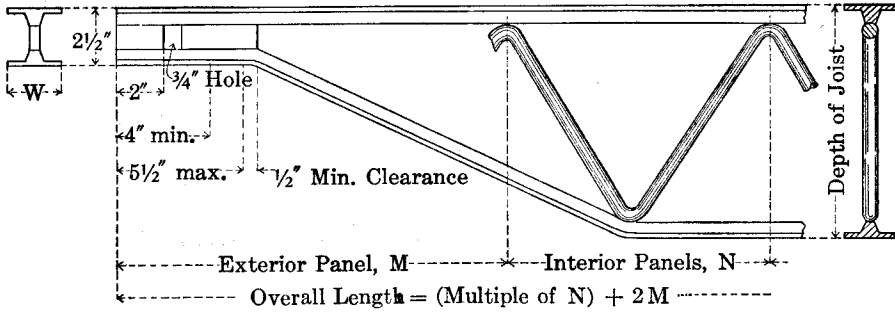
All joists are electrically welded.

Symbols consist of joist type number coupled with span in feet.

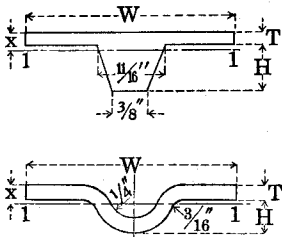
EXAMPLE: 82-15 is type 82 Joist, minimum span 15'-0", maximum span 16'-0" and is 16'-8" long.

TRUSCON OPEN WEB STEEL JOISTS

Manufactured by Truscon Steel Company



PROPERTIES OF CHORD SECTIONS



Section Number	Weight per Foot Lbs.	W In.	T In.	H In.	Area of Section In. ²	Axis 1-1		
						I In. ⁴	r In.	x In.
421	1.33	2 1/4	5/32	1 1/32	0.39	.0066	.13	.18
422	1.67	2 1/4	13/64	1 9/64	0.49	.009	.14	.18
423	1.98	2 1/4	9/64	1 1/2	0.58	.018	.18	.21
424	2.45	2 1/4	13/64	1 1/2	0.72	.025	.19	.22
425	3.03	2 1/2	1/4	1 1/2	0.89	.031	.19	.23
426	3.48	2 1/2	1/4	3/4	1.02	.074	.27	.31
427	4.27	2 3/4	5/16	3/4	1.26	.092	.27	.31

Joist Type	Top Chord Section Number	Bottom Chord Section Number	Joist Depth In.	Web In.	N In.	Lengths for Exterior Panels, M, Indicated by Suffix Letters					
						A Ft.-In.	B Ft.-In.	C Ft.-In.	D Ft.-In.	E Ft.-In.	F Ft.-In.
SJ 81	421	421	8	3/8	9	1- 2 1/2	1- 4	1- 5 1/2			
SJ 82	422	421	8	1/16	9	1- 2 1/2	1- 4	1- 5 1/2			
SJ 102	422	421	10	1/16	11 1/8	1- 4 5/8	1- 6 1/8	1- 7 5/8	1- 9 1/8		
SJ 103	423	422	10	1/16	11 1/8	1- 4 5/8	1- 6 1/8	1- 7 5/8	1- 9 1/8		
SJ 104	424	423	10	1/2	11 1/4	1- 4 3/4	1- 6 1/4	1- 7 3/4	1- 9 1/4		
SJ 123	423	422	12	1/2	13 5/8	1- 7 7/8	1- 8 5/8	1- 10 1/8	1- 11 5/8	2- 1 1/8	
SJ 124	424	423	12	1/2	13 5/8	1- 7 7/8	1- 8 5/8	1- 10 1/8	1- 11 5/8	2- 1 1/8	
SJ 125	425	424	12	1/2	13 5/8	1- 7 7/8	1- 8 5/8	1- 10 1/8	1- 11 5/8	2- 1 1/8	
SJ 126	426	425	12	9/16	13 3/8	1- 6 7/8	1- 8 3/8	1- 9 7/8	1- 11 3/8	2- 0 7/8	
SJ 145	425	424	14	9/16	15 3/4	1- 9 1/4	1- 10 3/4	2- 0 1/4	2- 1 3/4	2- 3 1/4	2- 4 3/4
SJ 146	426	425	14	9/16	15 3/4	1- 9 1/4	1- 10 3/4	2- 0 1/4	2- 1 3/4	2- 3 1/4	2- 4 3/4
SJ 147	427	426	14	5/8	15 1/4	1- 8 3/4	1- 10 1/4	1- 11 3/4	2- 1 1/4	2- 2 3/4	
SJ 166	426	425	16	5/8	17 7/8	1- 11 3/8	2- 0 7/8	2- 2 3/8	2- 3 7/8	2- 5 3/8	2- 6 7/8
SJ 167	427	426	16	5/8	17 7/8	1- 11 3/8	2- 0 7/8	2- 2 3/8	2- 3 7/8	2- 5 3/8	2- 6 7/8

The design of the Truscon Steel Joist is that of a Warren truss. The top and bottom chords consist of hot rolled special tee bars, except for light trusses, having a depth of ten inches or less, where cold rolled sections 421 and 422 are used. Web members are round bars.

Joists are assembled by means of electric forging.

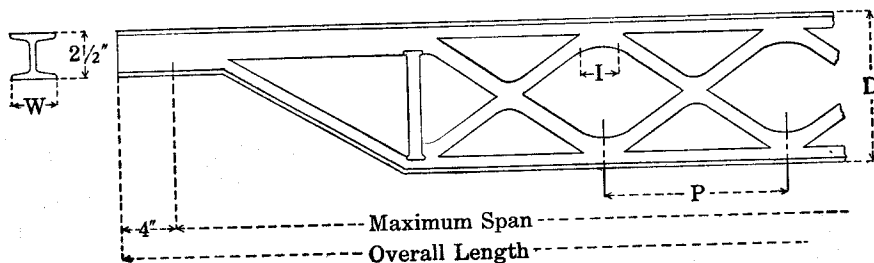
Joist lengths can be made to suit any span with the combinations of panels shown in above table.

The complete designation of a joist is shown by combining the "Joist Type," the number of interior, or N, panels, and the proper suffix letter to indicate length of the exterior panel, M.

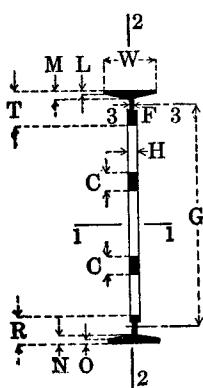
EXAMPLE: 125-08 C represents a joist, type 125, with 8 interior panels and exterior panels of length, C, making an overall dimension of 12'-9 1/4".

BATES-X OPEN WEB STEEL JOISTS

Manufactured by Bates Expanded Steel Corporation



PROPERTIES OF BATES JOISTS



JOIST TYPE	D	Top Chord			Bottom Chord Area	Web		Strut	
		Area	Axis 3-3			Area	f ² -2	Area	f ² -2
			S	r					
In.	In. ²	In. ³	In.	In. ²	In. ²	In.	In. ²	In.	
SJ 82	8	.5053	.105	.448	.443	.16	.072	.3068	.156
SJ 102	10	.5053	.105	.448	.443	.16	.072	.3068	.156
SJ 103	10	.602	.132	.45	.522	.20	.092	.3068	.156
SJ 104	10	.727	.126	.41	.621	.18	.084	.3068	.156
SJ 123	12	.562	.109	.41	.482	.24	.092	.3068	.156
SJ 124	12	.727	.126	.41	.621	.22	.084	.3068	.156
SJ 125	12	.85	.161	.422	.722	.24	.109	.3068	.156
SJ 145	14	.80	.148	.403	.674	.29	.109	.3068	.156
SJ 146	14	1.13	.159	.36	1.05	.29	.098	.3068	.156
SJ 166	16	1.13	.159	.36	1.05	.29	.098	.3068	.156

JOIST TYPE	D	W	G	T	R	C	H	F	L	M	O	N	P	I
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
SJ 82	8	1.50	7.25	1 3/8	1 1/8	5/8	.25	.15	.15	.206	.15	.206	12 1/8	2 1/8
SJ 102	10	1.50	9.25	1 3/8	1 1/8	5/8	.25	.15	.15	.206	.15	.206	17 1/4	2 1/2
SJ 103	10	1.57	9.17	1 3/8	1 1/8	5/8	.32	.22	.15	.206	.15	.206	17 1/4	2 1/2
SJ 104	10	1.83	9.27	1 3/8	1 1/8	5/8	.29	.23	.20	.266	.17	.236	17 1/4	2 1/2
SJ 123	12	1.57	11.29	1 1/4	1	3/4	.32	.22	.15	.206	.15	.206	22 1/8	2 1/2
SJ 124	12	1.83	11.38	1 1/4	1	3/4	.29	.23	.20	.266	.17	.236	22 1/8	2 1/2
SJ 125	12	1.92	11.19	1 3/8	1 1/8	5/8	.38	.32	.20	.266	.17	.236	22 1/8	2 1/2
SJ 145	14	1.92	13.30	1 1/4	1	3/4	.38	.32	.20	.266	.17	.236	25 1/2	2 1/2
SJ 146	14	2.80	13.42	1 1/4	1	7/8	.33	.33	.19	.396	.19	.396	25 1/2	2 1/2
SJ 166	16	2.80	15.42	1 1/4	1	7/8	.33	.33	.19	.396	.19	.396	29 1/2	2 1/2

The Bates One-piece Expanded Steel Joist is a continuous double lattice truss formed by slitting the webs of special rolled shapes, heating and expanding to the desired depth.

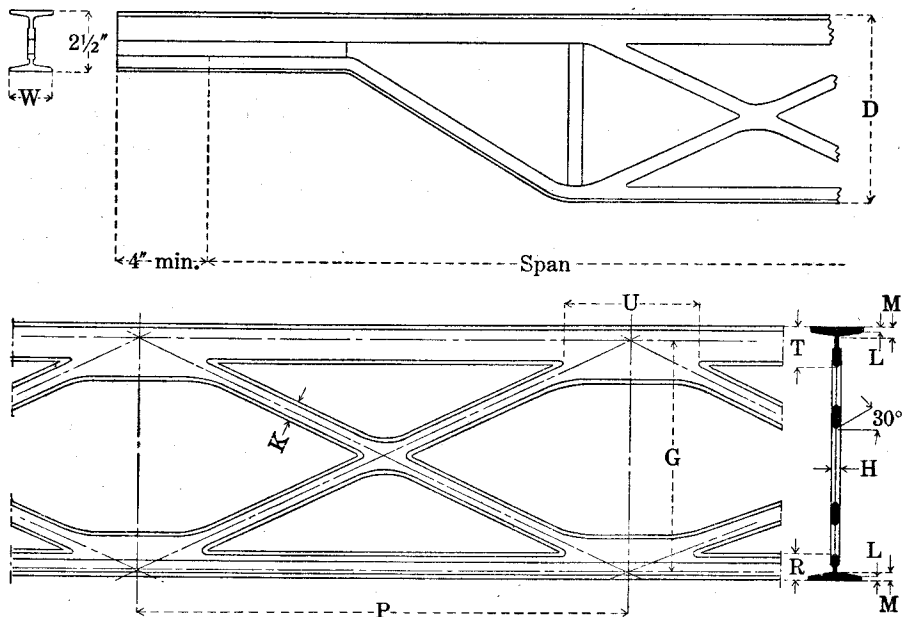
The ends are formed by bending up the bottom chord. Vertical struts are inserted and the bottom chord is secured to the upper portion of the web to give additional strength to the ends of the joist and so that the lower flange operates as the bearing member.

Its strength is uniform. The process of manufacture automatically tests every joist for any possible defect in either material or workmanship.

Its properties may be determined readily by standard formulae.

KALMANTRUSS OPEN WEB STEEL JOISTS

Manufactured by Kalman Steel Corporation



Joist Type	Span		D	G	W	H	K	L	M	P	R	T	U
	Min.	Max.											
	Ft.-In.	Ft.-In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
SJ 82	2-8	16-0	8	7.492	1.625	.280	.620	.120	.244	16	.657	1.205	4.38
SJ 102	3-4	16-8	10	9.554	1.625	.274	.700	.120	.244	20	.579	1.115	4.34
SJ 103	10-0	20-0	10	9.353	1.680	.348	.666	.145	.272	20	.832	1.413	5.02
SJ 104	14-2	20-0	10	9.370	2.000	.369	.665	.150	.301	20	.869	1.444	5.18
SJ 123	4-0	24-0	12	11.462	1.680	.337	.785	.145	.272	24	.725	1.275	4.99
SJ 124	15-0	24-0	12	11.468	2.000	.356	.787	.150	.301	24	.756	1.306	5.14
SJ 125	12-0	24-0	12	11.275	2.125	.406	.702	.162	.322	24	.975	1.665	5.77
SJ 126	12-0	24-0	12	11.295	2.625	.424	.704	.170	.370	24	1.025	1.715	6.03
SJ 145	4-8	28-0	14	13.385	2.125	.391	.835	.162	.322	28	.832	1.527	5.72
SJ 146	14-0	28-0	14	13.391	2.625	.408	.839	.170	.370	28	.882	1.577	5.96
SJ 166	5-4	32-0	16	15.377	2.667	.462	.855	.170	.370	32	.868	1.563	5.90

The Kalmantruss Joist is a lightweight double lattice truss, the body of which is made from a single piece of steel.

It is manufactured from a special shape by a continuous hot rolling process, in which the web is scored and the shape rolled out to the required depth of truss.

The ends are fabricated by bending up the bottom chord and inserting vertical struts.