ADDITIONAL
BETHLEHEM
STRUCTURAL
SHAPES

1921

BET TEEL COMPANY
HEM, PA.

ADDITIONAL BETHLEHEM STRUCTURAL SHAPES

ADDITIONAL BEAM SECTIONS

AND

SUPPLEMENTARY COLUMN SECTIONS

MANUFACTURED BY

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

GENERAL OFFICES:
At the Works, Bethlehem, Pa.

BRANCH SALES OFFICES:

BOSTON, 141 Milk Street.
NEW YORK, 111 Broadway.
PHILADELPHIA, Morris Building.
ATLANTA, Candler Building.
PITTSBURGH, First National Bank Building.
CLEVELAND, Guardian Building.
CHICAGO, Peoples Gas Building.
SAN FRANCISCO, Monadnock Building.

EXPLANATORY NOTES.

Large additional mill capacity, recently completed and put in operation for the production of wide flange structural shapes, has made it practical to add a number of new sections to our present established line of Bethlehem Structural Shapes. These new sections are now available and are shown in this pamphlet.

Three new beam sections are provided, viz.: B24b, B22 and B18a. The new 24″ and 18″ beams, B24b and B18a, are to supply the need for heavier 24″ and 18″ beams having a greater carrying capacity than our previous line of 24″ and 18″ beams afforded. The new 22″ beams, B22, supply sections intermediate in depth between 20″ and 24″, and will be found a desirable and economical addition to the range of beam sizes.

The comparison of the new 24″ and 18″ Bethlehem Beams with Standard Beams, is as follows:

Bethlehem Beams.	Section Modulus.	Standard Beams.	Section Modulus.
B24b, 104.5 lbs.	246.4	24″, 115.0 lbs.	246.3
99.5 lbs.	234.3	105.9 lbs.	234.3
B18a, 74.0 lbs.	136.6	18″, 85.0 lbs.	135.6
69.0 lbs.	126.9	75.6 lbs.	126.8

Particular attention is called to the manner in which the increase in weight of these beams is obtained by increasing the thickness of the flange as well as that of the web, instead of obtaining the entire addition in weight by increasing the thickness of the web only, as in previous methods. This entirely new method, on which patents are pending, permits obtaining an increase in Section Modulus practically proportional to the added weight. Thus B18a, 74 lbs., compared with B18a, 69 lbs., has an increase of 9.7 in Section Modulus, or about 7½ per cent increase in modulus, due to the increase of 5 lbs. in weight, which is about 7½ per cent increase in weight also. By the process of manufacture the addition to flange thickness is made to the outside of the flange thereby slightly increasing the depth of the beam, but the total variation in depth between minimum and maximum is not

more than the usual allowable tolerance in depth necessary in any method of rolling beams.

A considerable number of new Column Sections are provided, supplementing our previous list of H Columns, and affording a line of sections lighter than our regular H Columns. These supplementary column sections are to supply lighter columns for many purposes, including shop and mill building construction. A series of 6″ columns, in various weights, is provided for specially light construction.

The flanges of the new beams have a bevel of 8⅓ per cent, or a slope of 1 in 12. Flanges of the column sections have a uniform slope of 2 per cent.

All weights include fillets, but areas and all other properties are given exclusive of fillets.

Tolerances in weight and section, and all other regulations concerning material, lengths, etc., conform to the established rules applying to our regular Bethlehem Sections.

BENDING FACTORS.—To aid in the selection of columns subjected to direct loads and also to bending produced by eccentric loads or by other means, bending factors are given which furnish a convenient and practical method of converting the bending moment into an equivalent direct central load.

P′ —centrally applied load, in lbs.
P″ —eccentric load, in lbs.
m —bending moment, in inch lbs., produced by P″.
P‴—an equivalent central load, in lbs., producing the same maximum stress as bending moment.
P —total equivalent load on column, in lbs.
f —fiber stress, lbs. per sq. in., due to bending.
S —section modulus about axis of bending.
A —area of section, square inches.
k —bending factor = A ÷ S.

Then, $f = \frac{m}{S}$, and by assumption $\frac{P'''}{A} = f$.

But as $k = \frac{A}{S}$, then $f = \frac{mk}{A} = \frac{P'''}{A}$.

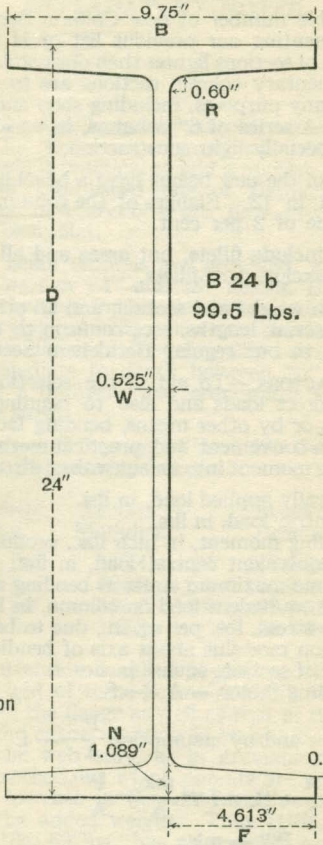
Therefore, $P''' = mk$,

and $P = P' + P'' + P''' = P' + P'' + mk$.

Hence, if the bending moment, in inch lbs., is multiplied by the bending factor, k, the product is an equivalent central load on the column producing the same compressive stress as the bending moment.

ADDITIONAL SECTIONS.

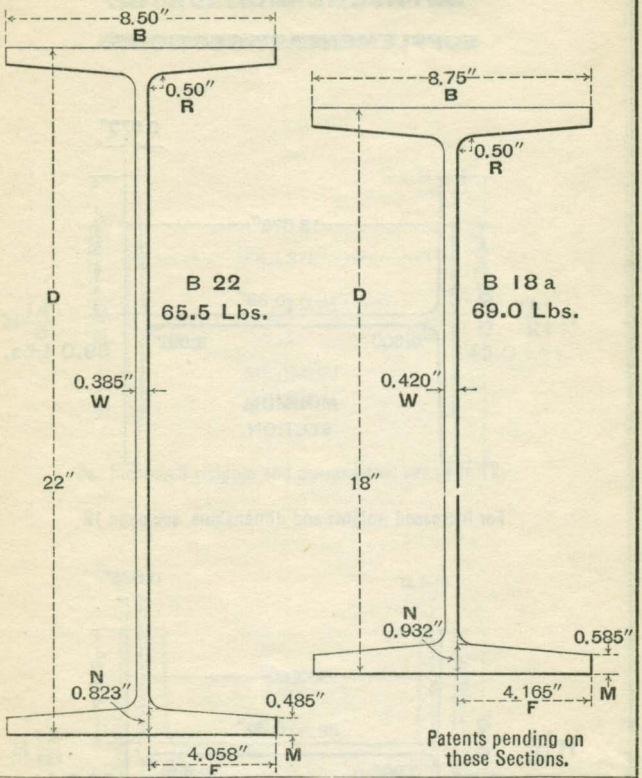
BETHLEHEM I BEAMS.



Section Number.	Weight, Lbs. per Foot.	Nominal Depth of Beam, Inches.	Dimensions, in Inches.						
			Nominal D	B	W	M	N	F	R
	104.5	$24\frac{3}{32}$	24.09	9.775	.550	.750	1.134	4.613	.60
B24b	**99.5**	**24**	**24.00**	**9.750**	**.525**	**.705**	**1.089**	**4.613**	**.60**
	95.5	$23\frac{29}{32}$	23.91	9.730	.505	.660	1.044	4.613	.60

ADDITIONAL SECTIONS.

BETHLEHEM I BEAMS.

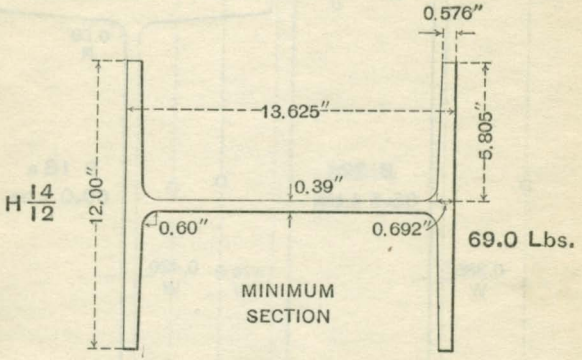


Patents pending on these Sections.

Section Number.	Weight, Lbs. per Foot.	Nominal Depth of Beam, Inches.	Dimensions, in Inches.						
			Nominal D	B	W	M	N	F	R
	71.5	22⅛	22.12	8.535	.420	.545	.883	4.058	.50
B22	68.5	22 1/16	22.06	8.520	.405	.515	.853	4.058	.50
	65.5	**22**	**22.00**	**8.500**	**.385**	**.485**	**.823**	**4.058**	**.50**
	74.0	18⅛	18.12	8.770	.440	.645	.992	4.165	.50
B18a	**69.0**	**18**	**18.00**	**8.750**	**.420**	**.585**	**.932**	**4.165**	**.50**
	64.5	17⅞	17.88	8.730	.400	.525	.872	4.165	.50

BETHLEHEM COLUMNS.

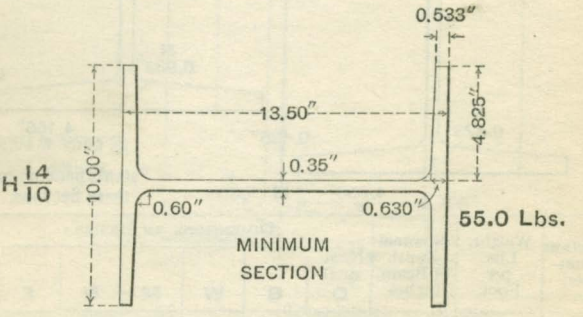
SUPPLEMENTARY SECTIONS.



H $\frac{14}{12}$

69.0 Lbs.

For increased weights and dimensions, see page 12.



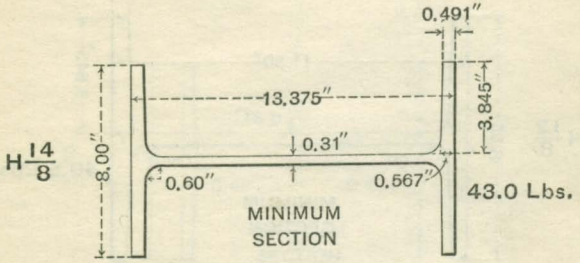
H $\frac{14}{10}$

55.0 Lbs.

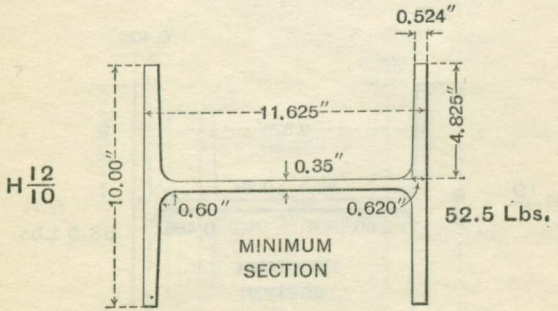
For increased weights and dimensions, see page 12.

BETHLEHEM COLUMNS.

SUPPLEMENTARY SECTIONS.



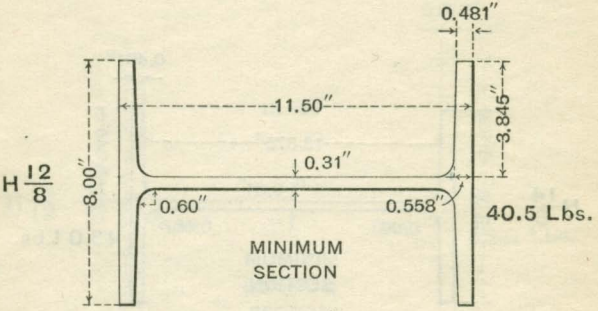
For increased weights and dimensions, see page 12.



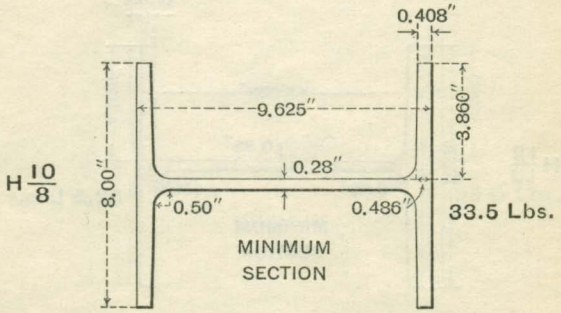
For increased weights and dimensions, see page 12.

BETHLEHEM COLUMNS.

SUPPLEMENTARY SECTIONS.



For increased weights and dimensions, see page 12.

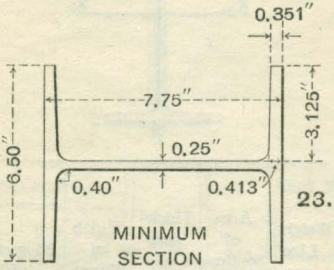


For increased weights and dimensions, see page 14.

BETHLEHEM COLUMNS.

SUPPLEMENTARY SECTIONS.

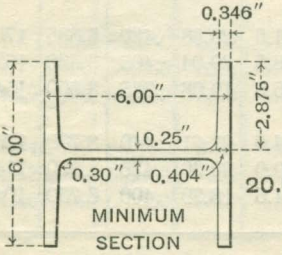
H $\frac{8}{6.5}$



23.5 Lbs.

For increased weights and dimensions, see page 14.

H 6



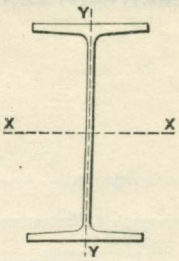
20.0 Lbs.

For increased weights and dimensions, see page 14.

PROPERTIES OF

BETHLEHEM I BEAMS.

ADDITIONAL SECTIONS.



Section Number.	Nominal Depth of Beam, Inches.	Weight, Lbs. per Foot.	Area of Section, Square Inches.	Thickness of Web, Inches.	Width of Flange, Inches.	Axis XX.		
						Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
	24 3/32	104.5	30.63	.550	9.775	2967.7	9.84	246.4
B24b	24	99.5	29.15	.525	9.750	2811.7	9.82	234.3
	23 29/32	95.5	27.79	.505	9.730	2663.1	9.79	222.8
	22 1/8	71.5	20.88	.420	8.535	1705.2	9.04	154.2
B22	22 1/16	68.5	20.04	.405	8.520	1629.3	9.02	147.7
	22	65.5	19.08	.385	8.500	1549.5	9.01	140.9
	18 1/8	74.0	21.61	.440	8.770	1238.0	7.57	136.6
B18a	18	69.0	20.20	.420	8.750	1142.5	7.52	126.9
	17 7/8	64.5	18.79	.400	8.730	1048.5	7.47	117.3

W=Safe load in pounds, uniformly distributed, including weight of beam.

L =Span, in feet.

M=Moment of forces, in foot pounds.

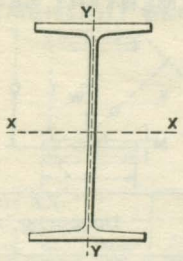
f =Allowable Fiber Stress, lbs. per square inch.

S =Section Modulus.

PROPERTIES OF

BETHLEHEM I BEAMS.

ADDITIONAL SECTIONS.



Coefficients of Strength.			Maximum Safe Shear on Web, in Pounds.	Axis YY.			Section Number.
For Fiber Stress of 16,000 Lbs. per Sq. In. Usual Building Code Requirement. C	For Fiber Stress of 12,000 Lbs. per Sq. In. For Moving Loads. C′	For Fiber Stress of 18,000 Lbs. per Sq. In. For Quiescent Loads. C″		Moment of Inertia. I′	Radius of Gyration. r′	Section Modulus. S′	
2,628,000	1,971,000	2,957,000	104,300	132.9	2.08	27.2	
2,499,000	1,874,000	2,812,000	95,900	124.8	2.07	25.6	B24b
2,376,000	1,782,000	2,673,000	89,300	117.1	2.05	24.1	
1,645,000	1,233,000	1,850,000	62,500	65.8	1.78	15.4	
1,576,000	1,182,000	1,773,000	58,200	62.3	1.76	14.6	B22
1,503,000	1,127,000	1,690,000	52,600	58.8	1.76	13.8	
1,458,000	1,093,000	1,640,000	66,100	82.9	1.96	18.9	
1,354,000	1,016,000	1,523,000	60,800	75.6	1.93	17.3	B18a
1,251,000	938,000	1,407,000	55,600	68.4	1.91	15.7	

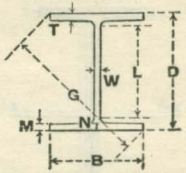
C, **C′**, and **C″**=Coefficients given in the table.

$W = \frac{C}{L}$, or $\frac{C'}{L}$, or $\frac{C''}{L}$

$M = \frac{C}{8}$, or $\frac{C'}{8}$, or $\frac{C''}{8}$

C, or C', or $C'' = WL = 8M = \frac{2}{3} f S$

DIMENSIONS AND PROPERTIES OF
BETHLEHEM COLUMNS.
14" AND 12"
SUPPLEMENTARY SECTIONS.

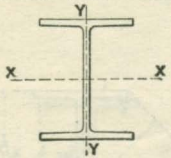


Section Number.	Weight of Section, Lbs. per Foot.	Dimensions, in Inches.							
		Nominal D	Nominal T	B	W	M	N	G	L
H 14/8	43.0	13 3/8	1/2	8.00	.31	.491	.567	15 9/16	11 1/16
	48.0	13 1/2	9/16	8.04	.35	.553	.630	15 11/16	11 1/16
	53.5	13 5/8	5/8	8.08	.39	.616	.692	15 13/16	11 1/16
	58.5	13 3/4	11/16	8.12	.43	.678	.755	16	11 1/16
H 14/10	55.0	13 1/2	9/16	10.00	.35	.533	.630	16 13/16	11 1/16
	61.5	13 5/8	5/8	10.04	.39	.596	.692	16 15/16	11 1/16
	67.5	13 3/4	11/16	10.08	.43	.658	.755	17 1/16	11 1/16
	73.5	13 7/8	3/4	10.12	.47	.721	.817	17 3/16	11 1/16
H 14/12	69.0	13 5/8	5/8	12.00	.39	.576	.692	18 1/8	11 1/16
	76.0	13 3/4	11/16	12.04	.43	.639	.755	18 1/4	11 1/16
	83.0	13 7/8	3/4	12.08	.47	.701	.817	18 3/8	11 1/16
	90.0	14	13/16	12.12	.51	.764	.880	18 1/2	11 1/16
H 12/8	40.5	11 1/2	1/2	8.00	.31	.481	.558	14	9 3/16
	45.5	11 5/8	9/16	8.04	.35	.543	.620	14 1/8	9 3/16
	50.5	11 3/4	5/8	8.08	.39	.606	.683	14 1/4	9 3/16
	55.0	11 7/8	11/16	8.12	.43	.668	.745	14 3/8	9 3/16
H 12/10	52.5	11 5/8	9/16	10.00	.35	.524	.620	15 5/16	9 3/16
	58.0	11 3/4	5/8	10.04	.39	.586	.683	15 7/16	9 3/16
	64.0	11 7/8	11/16	10.08	.43	.649	.745	15 9/16	9 3/16
	70.0	12	3/4	10.12	.47	.711	.808	15 11/16	9 3/16

DIMENSIONS AND PROPERTIES OF

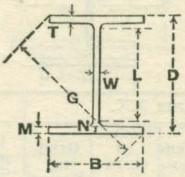
BETHLEHEM COLUMNS.

14" AND 12" SUPPLEMENTARY SECTIONS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	Axis XX.				Axis YY.			
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	Bending Factor. k	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	Bending Factor. k′
43.0	12.28	397.6	59.5	5.69	.207	43.6	10.9	1.88	1.127
48.0	13.82	450.9	66.8	5.71	.207	49.7	12.4	1.90	1.118
53.5	15.37	505.6	74.2	5.74	.207	56.0	13.9	1.91	1.110
58.5	16.93	561.6	81.7	5.76	.207	62.4	15.4	1.92	1.102
55.0	15.95	540.4	80.1	5.82	.199	93.1	18.6	2.42	.857
61.5	17.75	606.3	89.0	5.84	.199	104.8	20.9	2.43	.850
67.5	19.55	673.7	98.0	5.87	.200	116.8	23.2	2.44	.844
73.5	21.37	742.7	107.1	5.90	.200	129.0	25.5	2.46	.838
69.0	20.04	704.0	103.3	5.93	.194	174.7	29.1	2.95	.689
76.0	22.09	782.9	113.9	5.95	.194	194.7	32.3	2.97	.683
83.0	24.15	863.6	124.5	5.98	.194	215.0	35.6	2.98	.678
90.0	26.22	946.1	135.2	6.01	.194	235.8	38.9	3.00	.674
40.5	11.55	280.1	48.7	4.92	.237	42.8	10.7	1.92	1.081
45.5	13.02	318.8	54.8	4.95	.237	48.8	12.1	1.94	1.071
50.5	14.49	358.5	61.0	4.97	.237	55.1	13.6	1.95	1.063
55.0	15.98	399.3	67.3	5.00	.238	61.5	15.2	1.96	1.055
52.5	15.11	383.2	65.9	5.04	.229	91.5	18.3	2.46	.826
58.0	16.83	431.3	73.4	5.06	.229	103.2	20.5	2.48	.819
64.0	18.56	480.6	80.9	5.09	.229	115.1	22.8	2.49	.813
70.0	20.30	531.3	88.5	5.12	.229	127.3	25.2	2.50	.807

DIMENSIONS AND PROPERTIES OF
BETHLEHEM COLUMNS.
10", 8" AND 6"
SUPPLEMENTARY SECTIONS.



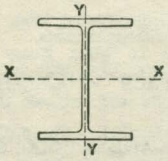
Section Number.	Weight of Section, Lbs. per Foot.	Dimensions, in Inches.							
		Nominal D	Nominal T	B	W	M	N	G	L
H 10/8	33.5	9 5/8	7/16	8.00	.28	.408	.486	12 1/2	7 11/16
	38.0	9 3/4	1/2	8.03	.31	.471	.548	12 5/8	7 11/16
	42.5	9 7/8	9/16	8.07	.35	.533	.611	12 3/4	7 11/16
	47.5	10	5/8	8.11	.39	.596	.673	12 7/8	7 11/16
H 8/6.5	23.5	7 3/4	3/8	6.50	.25	.351	.413	10 1/8	6 1/8
	27.0	7 7/8	7/16	6.53	.28	.413	.476	10 1/4	6 1/8
	30.5	8	1/2	6.56	.31	.476	.538	10 3/8	6 1/8
	34.5	8 1/8	9/16	6.60	.35	.538	.601	10 1/2	6 1/8
H6	20.0	6	3/8	6.00	.25	.346	.404	8 1/2	4 5/8
	23.0	6 1/8	7/16	6.02	.27	.409	.466	8 9/16	4 5/8
	26.5	6 1/4	1/2	6.06	.31	.471	.529	8 11/16	4 5/8
	30.0	6 3/8	9/16	6.10	.35	.534	.591	8 13/16	4 5/8
	33.5	6 1/2	5/8	6.14	.39	.596	.654	8 15/16	4 5/8
	37.0	6 5/8	11/16	6.18	.43	.659	.716	9 1/16	4 5/8
	40.5	6 3/4	3/4	6.22	.47	.721	.779	9 3/16	4 5/8

DIMENSIONS AND PROPERTIES OF

BETHLEHEM COLUMNS.

10", 8" AND 6"

SUPPLEMENTARY SECTIONS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	Axis XX.				Axis YY.			
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	Bending Factor. k	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	Bending Factor. k′
33.5	9.60	166.2	34.5	4.16	.278	36.6	9.14	1.95	1.050
38.0	10.89	192.0	39.4	4.20	.276	42.4	10.56	1.97	1.031
42.5	12.29	219.4	44.4	4.23	.277	48.5	12.02	1.99	1.022
47.5	13.70	247.6	49.5	4.25	.277	54.8	13.52	2.00	1.013
23.5	6.72	74.6	19.2	3.33	.349	16.8	5.17	1.58	1.298
27.0	7.76	88.2	22.4	3.37	.347	20.0	6.11	1.60	1.270
30.5	8.82	102.3	25.6	3.41	.345	23.2	7.07	1.62	1.248
34.5	9.97	117.4	28.9	3.43	.345	26.6	8.07	1.63	1.236
20.0	5.81	38.7	12.9	2.58	.451	13.0	4.34	1.50	1.340
23.0	6.69	45.9	15.0	2.62	.446	15.4	5.12	1.52	1.305
26.5	7.69	53.9	17.3	2.65	.445	18.1	5.96	1.53	1.290
30.0	8.70	62.4	19.6	2.68	.445	20.8	6.82	1.55	1.277
33.5	9.72	71.2	21.9	2.71	.444	23.6	7.69	1.56	1.264
37.0	10.76	80.4	24.3	2.73	.443	26.6	8.59	1.57	1.251
40.5	11.80	90.1	26.7	2.76	.442	29.6	9.52	1.58	1.240

BETHLEHEM STEEL COMPANY

BETHLEHEM, PA.

STRUCTURAL STEEL SHAPES: Bethlehem Beams, Girders and Columns; Standard Beams, Channels and Angles.

SHIPBUILDING SHAPES: Ship Channels and Bulb Angles.

STEEL PLATES: Open Hearth; Bridge, Structural, Ship and Tank quality.

PIG IRON: Basic, Bessemer, Foundry, Low Phosphorus, Mayari, Ferro-Manganese, Spiegeleisen.

CASTINGS: Steel and Iron, Brass, Bronze and Manganese.

FORGINGS: Drop, Hammered, Hydraulically Pressed, Solid and Hollow, Rough, and Finished Machined; Cement Mill, and Ore Crusher Balls.

RAILS: Standard, Girder, Guard, High Tee, Industrial Splice Bars, Tie Plates, Bolts, Frogs, Switches, Signals.

SWITCH STANDS: To Meet Every Track Condition; High, Intermediate and Low Stands, Adjustable and non-Adjustable.

MANARD ANVIL-FACE FROGS: Equipped with "Mayari" Never-Turn Bolts. All bolts receiving side thrust of wheels are HEAT-TREATED.

TOOL STEELS: Carbon, High Speed, Drill, Finishing and Special.

STANDARD ALLOY AND SPECIAL STEELS: Chrome Nickel, Chrome Vanadium, Mayari, Case Hardened, Special; Treated, Tempered and Cold Drawn.

TIN PLATES: Black, and Tinned Plates; Stamping and Enameling Stock.

SHEETS: Black, Blue-Annealed, Galvanized.

BAR IRON: Refined Bar Iron, Double Refined, Chain, Stay Bolt, Special Stay Bolt and Engine Bolt Iron.

BOLTS: All Kinds, Plain and Galvanized, Machine, Carriage, Lag, Plow and Patch; HEAT TREATED, Simple Alloy Mayari Steel Frog, Track and Fitting-Up Bolts.

NUTS: Hot and Cold Pressed, Cold Punched and Forged. All Sizes, Shapes and Standards, Blank or Tapped, Chamfered, Trimmed and Reamed Case Hardened, Castle, Semi-Finished and Finished.

RIVETS: Boiler, Bridge, Structural, Ship, Tank and Tap.

SPIKES: Steel and Iron, Standard, Railroad, Screw Railroad Track, Universal Screw, Boat, Dock and Wharf, Pressed and Rolled.

ENGINEERS AND BUILDERS OF SPECIAL MACHINERY.

FORGINGS AND CASTINGS FOR LARGE MARINE ENGINES.

HYDRAULIC BEAM AND GAP SHEARS, PLATE BENDING ROLLS, INTENSIFIERS, FLANGING AND FORGING PRESSES.

FURNACE AND FOUNDRY COKE AND COKE BY-PRODUCTS.

AMMONIUM SULPHATE, BENZOL, CRUDE NAPHTHALENE, SOLVENT NAPHTHAS, TOLUOL, TAR.

PUMPING ENGINES FOR MUNICIPAL PURPOSES, GAS ENGINES.

NAVAL AND COAST DEFENSE GUNS AND MOUNTS, FIELD GUNS AND HOWITZERS.

Gun Carriages, Limbers and Caissons, Gun Forgings, Torpedo Air Flasks, Armor Plate, Projectiles, Fuses, Cartridge Cases, Complete Rounds of Ammunition.

WORKS AT:

Bethlehem, Pa.; Lebanon, Pa.; Reading, Pa.; Steelton, Pa.; Sparrow's Point, Md.

GENERAL OFFICES—*Bethlehem, Pa.*

BRANCH OFFICES:

Atlanta, Ga.....Candler Building	New York, N. Y.....Trinity Bldg.
Boston, Mass.....Oliver Building	Philadelphia, Pa.....Morris Bldg.
Chicago, Ill.....Peoples Gas Bldg.	Pittsburgh, Pa.....First Nat'l. Bank Building
Cleveland, O.....Guardian Bldg.	
San Fran., Cal...Monadnock Bldg.	Washington, D. C.....Wilkins Bldg.

Foreign Representatives:

Consolidated Steel Corporation, 165 Broadway, New York.

ADDITIONAL BETHLEHEM STRUCTURAL SHAPES

1921

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

B.S.CO. PRINT