

Details and Cost Analysis of a Five Stall Engine House

by Roy A. Porterfield

May 15th, 1913

Submitted to the School of Engineering of the
University of Kansas in partial fulfillment of the
requirements for the Degree of Master of Science

DETAILS AND COST ANALYSIS
OF A FIVE STALL
ENGINE HOUSE

ROY A. PORTERFIELD

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DETAILS AND COST ANALYSIS
of a
FIVE STALL ENGINE HOUSE
for the
BINGHAM GARFIELD RAILWAY COMPANY, MAGNA, UTAH
by
ROY A. PORTERFIELD

Presented to the Faculty
of the
Graduate School
of the
University of Kansas

In Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE

May 15, 1913

Kansas City, Kansas.

May 15, 1913.

Professor H. A. Rice,
University of Kansas,
Lawrence, Kansas.

Dear Sir:

I submit the following thesis entitled, "Details and Cost Analysis of a Five Stall Engine House for the Bingham and Garfield Railway Company, Magna, Utah.

Yours truly,

Roy A. Porterfield

BIBLIOGRAPHY

Carnegie Steel Handbook.

Bethlehem Steel Handbook.

Smoley's Tables.

Kansas City Structural Steel Company's Standards.

OUTLINE

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- b.) Why chosen.

II. Design and Estimate.

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- b.) Work of contracting department.
- c.) Cost estimate.
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- d.) Cost table.
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In selecting this subject it was thought to be one which could be handled without trouble by one man, and yet would be a valuable addition to the Engineering Library, as it gives the actual cost of detailing and fabrication of steel structures.

In September, 1912, the Bingham Garfield Railway Company of Magna, Utah asked the Kansas City Structural Steel Company to submit plans and bids for a five-stall engine house 92'-0" x 111'-0".

The contracting department made a line diagram of the proposed building and an estimate of the cost. The doors, windows, corrugated roofing and siding, anchor bolts and louveres were to be furnished by the Bingham and Garfield Railway Company.

The design and bid of \$3,700.00 f.o.b. Magna, Utah was submitted, and after making a few changes in the design, the Steel Company were instructed to proceed with the work. The estimate

was as follows:

COST ESTIMATE

Material, 90,000# at	\$ 1.80
Details .....	.10
Shop Work .....	.75
Burden .....	.40
Freight, Kansas City to Magna Utah	<u>.57</u>
	\$3.62
90,000# at 3.62 per cwt.	\$3258.00
Profit	<u>442.00</u>
Total	\$3700.00

The item "burden" covers the cost (based on past work of the company) of the services of the contracting engineers, officers of the company, clerk department and other employees whose time can not be attached accurately to the various jobs of work.

A burden charge is also placed on the drafting and shop costs; but this is outside of the general burden charge and is included in the estimate of detailing and shop work. This charge is to cover the salaries of chief engineer, draftsmen in charge of work, superintendent of shops, shop foremen and inspectors. In the

drafting department one-third of the cost of the time spent by detailers and checkers is added for burden and for the shop burden one-half the cost of the laborers work is added.

After the railway company had approved the design and accepted the bid, the work was turned over to the drafting department for detailing. As the job was rather small, only two detailers had anything to do with the work; but it required about three hundred and fifty hours time to detail and check the work.

After the details were made and checked, bills of material for the detail sheets were made. These bills were then sent to the cost clerk who figured the accurate weight of material used in fabrication and its cost.

The bills of material and weight of steel on the different detail sheets are as follows:

Sheet No. 1 is the erection plan, and hence no bill of material is needed.

(See Sheet No. 2 on next page)

SHEET No. 2 - TRUSSES

No.	Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	:	L	: $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	: 14' 6 $\frac{1}{2}$ " abt	: A-2	:	: 119.2
2	:	L	: $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	: 36' 10 $\frac{3}{4}$ "	:	:	: 310.0
2	:	Chan.	: 4" @ 5 $\frac{1}{4}$ "#	: 36' 10"	:	:	: 387.4
2	:	L	: 3x3x5/16	: 36' 10"	:	:	: 448.5
4	:	L	: $3 \times 2\frac{1}{2} \times \frac{1}{4}$	: 12' 3 $\frac{1}{4}$ " abt	:	:	: 121.4
4	:	L	: $3 \times 3 \times \frac{1}{4}$	: 5' 8 $\frac{3}{4}$ "	:	:	: 139.8
4	:	P1	: 6 x 5/16	: 1' 5"	:	: Bent	: 34.7
4	:	P1	: 9 x 5/16	: 1' 3"	:	:	: 47.8
4	:	P1	: 5 x 5/16	: 0' 8 $\frac{1}{2}$ "	:	: Bent	: 15.1
105 Rivets 3/4" x 2"							40.6
30 Ring Fills 5/16 thick							12.2
4	:	L	: $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	: 14' 6 $\frac{1}{2}$ " abt	: L-M-N-P-2	:	: 238.4
2	:	L	: $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	: 36' 2 $\frac{3}{4}$ "	: L & M-2	:	: 296.8
2	:	L	: $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	: 36' 4 $\frac{3}{4}$ "	: N & P-2	:	: 297.4
8	:	L	: $3 \times 2\frac{1}{2} \times \frac{1}{4}$	: 12' 3 $\frac{1}{4}$ " abt	: L-M-N-P-2	:	: 441.6
8	:	L	: $3 \times 3 \times \frac{1}{4}$	: 5' 8 $\frac{3}{4}$ "	:	:	: 188.0
8	:	P1	: 6 x 5/16	: 1' 5"	:	: Bent	: 72.3
8	:	P1	: 9 x 5/16	: 1' 3"	:	:	: 95.6
8	:	P1	: 5 x 5/16	: 0' 8 $\frac{1}{2}$ "	:	: Bent	: 30.2
210 Rivets 3/4" x 2"							81.3
60 Ring Fills 5/16 thick							24.4

SHEET No. 2 - TRUSSES (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	L	3x3x5/16	35' 10 $\frac{1}{2}$ "	B-2		448.0
2	Chan.	6" @ 8#	36' 5 $\frac{1}{2}$ "			584.0
4	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	36' 5 $\frac{1}{2}$ "			598.0
8	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	12' 0" abt			393.8
4	L	3x3x1/4	5' 6 $\frac{1}{4}$ "			108.0
4	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	12' 4" abt			182.6
4	Pl	8 x 3/8	1' 11 $\frac{1}{2}$ "		Temp.	80.4
4	Pl	10 x 3/8	1' 3"		Temp.	63.8
4	Pl	7 x 3/8	1' 1"			38.8
150 Rivets 3/4" x 2						58.1
24 Ring Fills 3/8 thick						9.7
4	L	3x3x5/16	35' 7 $\frac{1}{2}$ "	C & D-2		859.0
4	Chan.	6" @ 8#	36' 2 $\frac{1}{2}$ "			1158.6
8	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	36' 2 $\frac{1}{2}$ "			1188.0
8	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	11' 9 $\frac{1}{2}$ " abt			349.0
8	L	3x3x $\frac{1}{4}$	5' 6 $\frac{1}{4}$ "			216.4
8	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	12' 4" abt			365.4
8	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	12' 0" abt			355.6
8	Pl	8 x 3/8	1' 11 $\frac{1}{2}$ "		Temp.	160.0
8	Pl	10 x 3/8	1' 3"		Temp.	127.5
8	Pl	7 x 3/8	1' 1"			77.5
300 Rivets 3/4" x 2						116.1
50 Ring Fills 5/16 thick						20.3

SHEET No. 2 - TRUSSES (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	: Chan.	: 4" 5 $\frac{1}{4}$ #	: 36' 5 $\frac{1}{2}$ "	: E-2	:	: 382.6
4	: Chan	: 4" 5 $\frac{1}{4}$ #	: 36' 2 $\frac{1}{2}$ "	: B & G-2	:	: 760.0
12	: L	: 2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	: 5' 3 $\frac{3}{4}$ "	: H & K-2	:	: 261.4
12	: L	: 5 x 3x5/16	: 0' 3"	: H & K-2	:	: 26.1
24 Rivets 3/4" x 2						9.7
4	: Chan.	: 4" @ 5 $\frac{1}{4}$ #	: 37' 1 $\frac{1}{2}$ "	: L-M-N-P-2	:	: 778.5
4	: L	: 3x3x5/16	: 37' 1 $\frac{1}{2}$ "	:	:	: 950.0
Total Sheet 2						14,169.6

SHEET No. 3 - COLUMNS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
4	: H	: 6" @ 23.8#	: 32' 2"	: A3 & B3	: Mill one end	: 3060.0
16	: L	: 3"x2 $\frac{1}{2}$ x $\frac{1}{4}$	: 0' 5"	:	:	: 25.0
8	: L	: 3x3x $\frac{1}{4}$	: 0' 9"	:	:	: 29.4
4	: Pl	: 8 x 1/2	: 1' 8"	:	:	: 63.4
8	: L	: 6x4x3/8	: 0' 8"	:	: Temp.	: 65.6
96 Rivets 3/4" x 2 $\frac{1}{4}$ "						40.2
16	: H	: 5" @ 18.7#	: 20' 2 $\frac{3}{4}$ "	: C3 & L3	: Mill one end	: 5852.0
48	: Pl	: 2 x 3/8	: 0' 5"	:	:	: 50.0
16	: Pl	: 8 x 1/2	: 1' 1"	:	:	: 224.4
32	: L	: 6x4x3/8	: 0' 8"	:	: Temp.	: 262.4
240 Rivets 3/4" x 2 $\frac{1}{4}$ "						100.5

SHEET No. 3 - COLUMNS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	H	6" @ 23.8#	32' 2"	D3 & E3	Mill one end	1850.0
2	Pl	8" x 1/2"	1' 2"			31.6
4	L	6x4x3/8	0' 8"		Temp.	32.8
4	L	3x2 1/2 x 1/4	0' 5"			7.6
2	L	3x3x1/4	0' 9"			7.4
2	L	3x3x1/4	0' 9 3/4"			8.0
21 Rivets 3/4 x 2 1/4"						8.2
2	H	6" @ 23.8#	35' 10 1/4"	F3 & G3	Mill one end	2064.0
2	Pl	8 x 1/2	1' 2"			31.6
4	L	6x4x3/8	0' 8"		Temp.	32.8
2	L	3x3x1/4	0' 6"			4.9
30 Rivets 3/4" x 2 1/8"						12.3
2	H	6" @ 23.8#	32' 2"	H3 & K3	Mill one end	1850.0
2	Pl	8 x 1/2	1' 2"			31.6
4	L	6x4x3/8	0' 8"		Temp.	32.8
4	L	3x2 1/2 x 1/4	0' 5"			7.6
2	L	3x3x1/4	0' 9"			7.4
36 Rivets 3/4" x 2 1/4"						15.0
Total Sheet 3						15,798.5

SHEET No. 4 - PURLINS, GIRTS AND BRACING

Pieces	Shape	Size	Length	Mark	Remarks	Weight
12	: Chan. :	4" @ 5 $\frac{1}{4}$ "#	: 36' 11 $\frac{1}{2}$ "	: A4 & G4	:	: 2324.0
24	: Chan. :	4" @ 5 $\frac{1}{4}$ "#	: 37' 2"	: B4 & F4	:	: 4684.0
10	: Chan. :	4" @ 5 $\frac{1}{4}$ "#	: 36' 11 $\frac{1}{2}$ "	: C4	:	: 1942.0
20	: Chan. :	4" @ 5 $\frac{1}{4}$ "#	: 37' 2"	: H4	:	: 3908.0
3	: L :	3x3x $\frac{1}{4}$ "	: 15' 11"	: BS4 - BT4	:	: 234.0
4	: L :	3x3x $\frac{1}{4}$ "	: 15' 11"	: CD4 - CF4 - CG4	:	: 312.0
36	: L :	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$ "	: 12' 3 $\frac{1}{2}$ "	: K4	:	: 1812.0
36	: L :	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$ "	: 10' 8 $\frac{3}{8}$ "	: L4 - M4	:	: 1578.0
16	: L :	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$ "	: 2' 10 $\frac{1}{4}$ "	: N4	:	: 186.4
4	: L :	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$ "	: 1' 4 $\frac{3}{4}$ "	: P4 - R4	:	: 22.8
2	: L :	3x3x $\frac{1}{4}$ "	: 7' 5 $\frac{1}{4}$ "	: S4 - T4	:	: 77.8
2	: L :	3x3x $\frac{1}{4}$ "	: 8' 6"	: D4 - E4	:	: 83.3
4	: L :	3x3x $\frac{1}{4}$ "	: 16' 9"	: AB4 - AC4	:	: 328.0
4	: L :	3x3x $\frac{1}{4}$ "	: 0' 3"	:	:	: 4.9
4	Rivets 3/4" x 1 7/8"					1.6
4	: L :	3x3x $\frac{1}{4}$ "	: 22' 1 $\frac{1}{2}$ "	: AD4 - AE4	:	: 433.2
7	: L :	3x3x $\frac{1}{4}$ "	: 15' 11"	: AF4 - AG4	:	: 546.6
4	: L :	3x3x $\frac{1}{4}$ "	: 16' 3 $\frac{1}{2}$ "	: AH4 AK4 - BP4 AL4 - BR4	:	: 319.6
2	: L :	3x3x $\frac{1}{4}$ "	: 16' 9"	: AM4 - AN4	:	: 164.3
2	: L :	3x3x $\frac{1}{4}$ "	: 0' 3"	:	:	: 2.5
2	Rivets 3/4 x 1 7/8"					0.8
6	: L :	3x3x $\frac{1}{4}$ "	: 22' 1 $\frac{1}{2}$ "	: AP4 - BM4 AR4 - BN4	:	: 650.0

SHEET No. 4 - PURLINS, GIRTS AND BRACING (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	L	3x3x $\frac{1}{4}$	24' 7"	AS4 - AT4		240.8
4	P1	2 $\frac{1}{2}$ x $\frac{1}{4}$	0' 7 $\frac{1}{2}$ "			5.3
4	Rivets	3/4 x 1 7/8"				1.6
2	L	3x3x $\frac{1}{4}$	22' 3 $\frac{1}{4}$ "	BE4 -BF4		218.4
2	L	6x3 $\frac{1}{2}$ x3/8	0' 8 $\frac{1}{4}$ "			16.1
4	Rivets	3/4 x 2"				1.6
2	L	3x3x $\frac{1}{4}$	24' 1 $\frac{1}{4}$ "	BG4 - BH4		237.4
2	L	3x3x $\frac{1}{4}$	21' 4 $\frac{1}{2}$ "	BK4 - BL4		238.6
2	L	6x3 $\frac{1}{2}$ x3/8	0' 8"			15.6
4	Rivets	3/4 x 2"				1.6
8	L	3x3x $\frac{1}{4}$	10' 9 3/8"	CS4 - CT4		422.4
16	L	3x3x $\frac{1}{4}$	1' 6 $\frac{1}{4}$ "	BD4 - BC4		121.0
32	L	3x3x $\frac{1}{4}$	0' 3"			78.4
32	Rivets	3/4 x 1 7/8"				12.8
8	L	3x3x $\frac{1}{4}$	6' 11"	CH4 - CK4		271.5
8	L	3x3x $\frac{1}{4}$	0' 3"			9.8
8	Rivets	3/4 x 1 7/8"				3.2
2	L	3x3x $\frac{1}{4}$	4' 0"	CL4 - CM4		39.2
2	L	3x3x $\frac{1}{4}$	0' 3"			2.5
2	Rivets	3/4 x 1 7/8"				0.8

SHEET No. 5 - ROOF TRUSSES (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
8	L	3x2x $\frac{1}{4}$	1' 2 $\frac{1}{4}$ " abt			38.7
8	Pl	8 x 3/8	0' 8" abt	(L)		54.4
8	Pl	5 x 5/16	0' 9" abt	(B)	Temp.	31.8
4	Pl	12 x 7/16	1' 8" abt	(C)	Temp.	120.6
4	Pl	12 x 1/2	2' 3 $\frac{1}{2}$ " abt	(H)		187.0
4	Pl	12 x 3/8	1' 5" abt	(D)	Temp.	87.0
4	Pl	8 x 3/8	0' 9" abt	(G)		30.6
4	Pl	5 x 5/16	1' 2 $\frac{1}{2}$ " abt	(E)		25.6
2	Pl	17 x 1/2	2' 0"	A5 (F)	Temp.	115.6
16	L	3x2 $\frac{1}{2}$ x $\frac{1}{4}$	0' 7"	A & B		42.8
8	L	3 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	0' 10"			32.5
60 Ring Fills 3/4" x 7/16" thick						33.9
500 Rivets 3/4" x 2 $\frac{1}{4}$ "						209.0
4	L	3x2 $\frac{1}{2}$ x5/16	16' 0 $\frac{1}{4}$ "	C5		359.4
4	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	7' 2 1/8"	D5		106.4
2	Pl	5 x 5/16	0' 8"	D5		7.1
6 Rivets 3/4" x 2"						0.3
1 Ring Fill 3/4" x 5/16" thick						0.8
8	L	3x2 $\frac{1}{2}$ x $\frac{1}{4}$	10' 4 $\frac{1}{4}$ "	E5		364.2
4	Pl	8 x 3/8	1' 8"		Temp.	68.0
8	L	3x2x $\frac{1}{4}$	1' 1"			35.6
40 Rivets 3/4" x 2 $\frac{1}{4}$ "						16.7
8 Ring Fills 3/4" x 3/8"						3.8

SHEET No. 5 - ROOF TRUSSES (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
8	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 8 $\frac{3}{8}$ "	F5		109.4
8	Rivets	$\frac{3}{4}$ " x $2\frac{1}{4}$ " long				3.3
8	Ring Fills	$\frac{3}{4}$ " x $\frac{1}{4}$ " thick				3.3
2	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 2 $\frac{3}{8}$ "	G5		29.2
4	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 10 $\frac{3}{4}$ "	H5		64.8
2	Pl	8 x $\frac{1}{4}$	0' 8"		Temp.	9.1
2	Pl	8 x $\frac{1}{4}$	1' 0 $\frac{1}{2}$ "		Temp.	14.1
2	L	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	0' 5 $\frac{1}{4}$ "			4.0
14	Rivets	$\frac{3}{4}$ " x $2\frac{1}{4}$ "				5.9
2	Ring Fills	$\frac{3}{4}$ " x $\frac{1}{4}$ "				0.8
4	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 10 $\frac{3}{4}$ "	K5		64.8
2	Pl	8 x $\frac{1}{4}$	0' 8"		Temp.	9.1
2	L	$3 \times 2\frac{1}{2} \times \frac{1}{4}$	0' 5 $\frac{1}{4}$ "			4.0
10	Rivets	$\frac{3}{4}$ " x $2\frac{1}{4}$ "				4.1
2	Ring Fills	$\frac{3}{4}$ " x $\frac{1}{4}$ "				0.8
4	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	3' 9 $\frac{3}{4}$ "	L5		56.5
16	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 8 $\frac{3}{8}$ "	M & N5		242.6
8	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	3' 2 $\frac{3}{8}$ "	G5		93.5
16	L	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$	3' 10 $\frac{3}{4}$ "	R5 & P5		255.8
16	PL	8 x $\frac{1}{4}$	0' 8"		Temp.	72.8
16	L	$5 \times 3 \times \frac{5}{16}$	0' 2 $\frac{1}{2}$ "			27.3
8	Pl	8 x $\frac{1}{4}$	1' 0 $\frac{1}{2}$ "		Temp.	36.4
80	Rivets	$\frac{3}{4}$ " x $2\frac{1}{4}$ "				33.4

SHEET No. 5 - ROOF TRUSSES (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
16	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	4' 0 $\frac{3}{4}$ "	S5		266.0
12	Rod	$\frac{3}{4}$ " ϕ	23' 3"	R1	Threaded on both ends 2"	837.0
24	L	$5 \times 3\frac{1}{2} \times 3/8$ "	0' 3 $\frac{1}{2}$ "		Cut to 5x3 5/16	72.8
24	3/4" Nuts					13.2
Total Sheet 5						8020.1

SHEET No. 6 - RAFTERS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
12	Chan.	8" @ 11 $\frac{1}{4}$ #	25' 1 $\frac{3}{4}$ "	A6-B6-C6-D6		3393.9
48	L	$5 \times 3 \times 5/16$	0' 2 $\frac{1}{2}$ "			82.0
12	P1	5 x 5/16"	0' 9"			47.7
120	Rivets	$3/4 \times 2 \ 1/8$ "				50.2
6	P1	14" x 3/8"	1' 5"	A6 C6		151.8
24	Rivets	$3/4 \times 2$ "				9.3
12	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	5' 11 1/8"	E6 H6		263.2
12	P1	5 x 5/16"	0' 10"			53.1
24	Rivets	$3/4$ " x 2"				9.3
4	Chan.	8" @ 11 $\frac{1}{4}$ #	25' 1 $\frac{3}{4}$ "	F6-G6-K6-L6		1131.3
16	L	$5 \times 3 \times 5/16$	0' 2 $\frac{1}{2}$ "			27.3
4	P1	5 x 5/16"	0' 9"			15.9
40	Rivets	$3/4 \times 2 \ 1/8$ "				16.7
2	P1	14 x 3/8"	1' 5"	K6 F6		50.6
8	Rivets	$3/4$ " x 2"				3.1
Total Sheet 6						5305.4

SHEET No. 7 - COLUMNS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
4	L	3x3x $\frac{1}{4}$	20' 2 $\frac{3}{4}$ "	A7 - B7		356.1
4	L	5x3x $\frac{3}{8}$	0' 6"			19.6
4	L	5x3x $\frac{3}{8}$	0' 3"			9.8
4	Pl	6" x 1/2"	0' 6"			20.4
24 Rivets 3/4" x 2"						9.5
2	Chan.	8" @ 11 $\frac{1}{4}$ "#	21' 8 $\frac{1}{4}$ "	C7 - D7		488.0
2	L	6x4x $\frac{3}{8}$	0' 6"			12.3
8 Rivets 3/4 x 2"						3.1
2	Chan.	8" x 11 $\frac{1}{4}$ "#	21' 8 $\frac{1}{4}$ "	K7 - L7		488.0
2	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	18' 11 $\frac{1}{4}$ "			155.6
2	L	6x4x $\frac{3}{8}$	0' 6"			12.3
28 Rivets 3/4" x 2"						10.9
2	Chan.	8" x 11 $\frac{1}{4}$ "#	35' 9"	M7 - N7		804.4
2	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	18' 11 $\frac{3}{4}$ "			155.6
2	L	6 x 4 x $\frac{3}{8}$	0' 6"			12.3
28 Rivets 3/4" x 2"						10.9
2	Chan.	8" x 11 $\frac{1}{4}$ "#	36' 2 $\frac{1}{2}$ "	P7 - R7		817.7
2	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	18' 11 $\frac{3}{4}$ "			155.6
2	L	6x4x $\frac{3}{8}$	0' 6"			12.3
28 Rivets 3/4" x 2"						10.9

SHEET No. 7 - COLUMNS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
6	Chan.	8" @ 11 $\frac{1}{4}$ "#	19' 2 $\frac{3}{4}$ "	E7-G7-F7-H7		1293.1
6	L	2 $\frac{1}{2}$ x2 $\frac{1}{2}$ x $\frac{1}{4}$	18' 11 $\frac{3}{4}$ "			466.8
6	L	6x4x3/8	0' 6"			36.9
84	Rivets	3/4" x 2"				32.6
Total Sheet 7.						5,374.7

SHEET No. 8
BRACING AND RAFTERS

Pieces	Shape	Size	Length	Mark	Remarks	Weight
2	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	20' 0"	C8		148.0
2	L	6x3 $\frac{1}{2}$ x3/8	0' 5"			9.8
2	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	20' 2 $\frac{3}{4}$ "	B8		150.0
2	L	6x3 $\frac{1}{2}$ x3/8	0' 5"			9.8
2	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	19' 11 $\frac{1}{4}$ "	D8		147.8
2	L	6x4x3/8	0' 6"			12.3
2	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	19' 8 $\frac{1}{2}$ "	A8		145.8
2	L	6x4x3/8	0' 6"			12.3
2	Pl	7 x $\frac{1}{4}$ "	1' 6"			17.7
20	Rivets	3/4" x 2"		C8-B8-D8-A8		7.7
4	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	21' 7 $\frac{1}{2}$ "	H8 F8		320.4
4	L	2 $\frac{1}{2}$ x2x $\frac{1}{4}$	21' 5 $\frac{1}{4}$ "	E8 G8		318.6
2	Pl	8 x 1/4"	1' 4"	E8		18.1
4	Rivets	3/4" x 2"				1.5

SHEET No. 8 (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
4	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	13' 3"	K8 - L8		196.4
8	Pl	8 x 1/4	0' 8 $\frac{1}{2}$ "			38.7
16	Rivets	3/4" x 1 7/8"				6.2
4	Chan.	8" @ 11 $\frac{1}{4}$ #	23' 0"	M8 - N8		1053.0
20	L	$5 \times 3\frac{1}{2} \times 3/8$	0' 2 $\frac{1}{2}$ "			36.3
40	Rivets	3/4" x 21/8"				15.5
12	I	8" @ 18#	22' 3 $\frac{1}{2}$ "	P8-R8-S8-T8		4815.0
60	L	$3 \times 2\frac{1}{2} \times 5/16$	0' 5 $\frac{1}{2}$ "			181.8
24	L	$6 \times 3\frac{1}{2} \times 3/8$	0' 5"		Cut to 6x2 $\frac{1}{2}$ x3/8	117.0
156	Rivets	3/4" x 21/8"				61.0
32	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$	7' 0"	AB8		868.4
32	Pl	5 x 1/4	0' 10 $\frac{3}{4}$ "		Bent	122.4
128	Rivets	3/4" x 1 7/8"				49.4
48	Rivets	5/8" x 1 7/8"				13.7
24	L	$2\frac{1}{2} \times 2 \times \frac{1}{4}$ "	5' 1 $\frac{1}{4}$ "	AC8		454.0
12	Pl	5 x 1/4"	0' 11 $\frac{1}{4}$ "		Bent	47.8
12	Pl	5 x 1/4"	0' 10 $\frac{3}{4}$ "		Bent	45.7
96	Rivets	3/4" x 1 7/8"				37.1
36	Rivets	5/8" x 1 7/8"				10.3
14	B.Pl	5 x 1/4"	2' 0"	AK8		119.0
2	L	5x3x5/16	2' 0"	AL8 - AM8		34.8

SHEET No. 8 (con)

Pieces	Shape	Size	Length	Mark	Remarks	Weight
4	I	8" @ 18#	22' 2½"	AD8 AE8		1599.0
20	L	3x2½x5/16	0' 5½"			41.2
8	L	6x3½x3/8	0' 5"		:Cut to 6x2½x3/8	39.0
8	L	5x3x3/8	0' 5"		:Cut to 5x2½x2/8	32.8
40 Rivets ¾" x 2"						15.5
24 Rivets ¾" x 3 3/8"						13.8
8	L	2½x2x½	5' 7¼"	AF 8		161.0
4	Pl	5 x ¼"	0' 10¾"		: Bent	15.0
4	Pl	5 x ¼"	0' 11½"		: Bent	16.3
32 Rivets ¾" x 2 1/8"						12.4
12 Rivets 5/8 x 2¼"						3.2
8	L	2½x2½x¼	11' 10½"	AG8 AH8		392.8
4	L	2½x2½x¼	11' 10"			195.4
4	Chan.	4" @ 5¼#	36' 11¾"			776.0
72 Rivets ¾" x 1 7/8"						27.9
2	Chan.	4" @ 5¼#	36' 11¾"	AK8		388.0
6	L	2½x2½x¼	11' 10½"			292.0
32 Rivets ¾" x 1 7/8"						12.4

Total Sheet 8 13,276.2

STOREKEEPER'S LIST - ERECTION BOLTS, RIVETS, ETC.

RIVETS

No.	Size	Length	Weight
330	3/4 ϕ	1 7/8"	122.4
310	-	2"	120.0
310	-	2 1/4"	129.8
80	-	2 1/2"	35.9
30	-	2 3/4"	14.4
100	5/8 ϕ	2"	28.5
25	-	2 3/8"	8.0
20	-	3	7.4
			466.4

BOLTS

No.	Size	Length	Weight
240	3/4 ϕ	1 1/2	151.2
750	-	1 3/4	495.0
125	-	2"	86.3
50	-	3"	40.5
25	5/8 ϕ	1 1/4	10.0
15	-	1 3/4	6.2
10	-	2 1/2	4.8
			794.0

MISCELLANEOUS MATERIAL

1000 Std. Cut Washers for 1/2" Bolt 100.0

Total Storekeeper's List...1360.4

TOTAL WEIGHT

Sheet 1	Erection Plan	
Sheet 2		14,169.6
Sheet 3		15,798.5
Sheet 4		22,593.4
Sheet 5		8,020.1
Sheet 6		5,305.4
Sheet 7		5,374.7
Sheet 8		13,276.2
Store keeper's list		<u>1,360.4</u>
Total		86,298.3

When the order was closed, the cost of furnishing the material was as shown in the following table:

COST

Material		\$1486.57
Erection Bolts and Rivets (Storekeeper's list)		115.43
Details :..	(Labor \$149.98 { Burden <u>50.01</u>)	199.99
Shop.....	(Labor \$269.35 { Burden <u>134.68</u>)	404.03
Burden		357.36
Freight		483.42
Drafting and Shop errors ...		<u>54.18</u>
Total		\$3100.98

Cost	\$3100.98
Profit	<u>599.02</u>
Price	\$3700.00

The profit for the company on the work was \$599.02 or 19.3 per cent.

In the drafting errors were failure to cut the connection angles on four rafters AD8 and AE8, so that they would fit the web of columns A3 and B3. This was caused by an inaccuracy in the manufacturer's hand book, giving the tangent distances of the H columns and hence the connection angles were not cut small enough to slip in on the web, and the error in the handbook was not known in time to make a shop change on the work, and so catch the error before the material left the shop. The other drafting errors were due to failure to show holes for wood nailing strips in the webs of rafter M8 and N8 and in one leg of the angles on the monitor members H5 and K5. (See detail sheets.). These errors amounted to \$22.25 worth of work in the field. The shop errors were in leaving out holes for wood nailing strips in two or three members, failing to punch holes in columns for angle bracing and riviting bent gusset plates on the trusses reverse from what they should

have been. These errors increased the bill for errors to \$54.18.

The following table gives a comparison of the estimated and actual cost.

	COST	
	Estimated	Actual
Material	\$1620.00	\$1602.00
Details	90.00	199.99
Shop work	675.00	404.03
Burden	360.00	357.36
Freight	513.00	483.42
Errors	<u> </u>	<u>54.18</u>
Totals	\$3258.00	\$3100.98

The largest variation in proportion to the magnitude of the items was in the detailing which cost more than twice the estimated cost. The largest variation in actual cost, was in the shop work, which cost less than two thirds of the estimated cost. The other items checked very closely the estimated cost.

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