A STRESS ANALYSIS OF LOUISE H. CAMPBELL HALL

Thesis for the Degree of B. S.

MICHIGAN STATE COLLEGE

George Koopman

1939

A Stress Analysis of Louise H.

Campbell Hall

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

by

George Koopman

Candidate for the Degree of

Bachelor of Science

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The structure considered is a Girl's Dormitory, erected on the Michigan State College Campus in the spring and summer of 1939 by the Alfred A Smith Construction Co. of Detroit. The building was designed by Malcomlson, Calder, and Hammond Architects and Engineers of Detroit, Michigan, to accomodate approximately fove hundred girls.

The analysis was performed with the intent to gain an insight into and a more thorough knowledge of the practical aspects of structural engineering, and also to gain experience in the performance of structural analysis.

The author wishes to acknowledge the help of Mr. C. L. Allen for his aid and advice in making the analysis, Mr. Ralph Calder for his generosity in supplying the structural plans of the building, and Mr. Gerard of the firm of Malcolmson, Calder and Hammond for his welcome hints and advice pertaining practical structural engineering.

References

Reinforced Concrete Structures

by Peabody

Design of Steel Structures

by Urquhart and O'Rourke

Steel Construction
by American Institute of Steel Construction

Carnegie Pocket Companion

by United States Steel Company

Specifications

Loads:-

Dead loads:-

Snow load (30-(45-20)1) 51b./sq. ft. —?

Wind load 30 lb./sq. ft. on the vertical plane as recommended by the Detroit City building code.

Normal wind load $\frac{30X2X0.707}{1.5}$ = 28 lb. / sq. ft.

Roof covering

Gypsum tile	17 lb./sq/ ft/
Asphalt felt	2 " " "
Slate shingles	6 " " "
Total Dead roof load	58 lb./sq. ft.

Live loads:-

Taken from the Detroit City Code for hotels and dormitories

On upper floors	50 lb./sq. ft.
First floor and halls	80 lb./sq. ft.
Shower and toilet floors	100 lb./sq. ft.

Weight of concrete 150 lb./ sq. ft.

Tile and gypsum soundproofed walls 40 lb./sq. ft.

Purlins:-

considered as simply supported with uniform load.

$M = \frac{wl^2}{8}$ where M is the maximum bending moment in the purlin, w is the load per foot, and l is the length of the purlin in feet. Compare the moment of inertia I of the member taken from the tables with the I required as computed from the formula $s=\frac{Mc}{I}$ where

s is the unit working stress of steel taken as 18000 lb. per square inch, M is the above moment, c is the distance in inches from the neutral axis to the outermost fiber, and I is the moment of inertia about the neutral axis. Check the shear. the allowable is 13,500 lb. per square inch.

Rafters:-

Considered as having three point suspension with the loads concentrated at the purlins. Compare the I of the member with the I required as with the purlins.

Columns:-

Roof: Allowable concentric loadings checked, plus bending moment due to a possible horizontal thrust of the wind. Allowable vertical loadings were taken from Steel Construction by American Institute of Steel Construction.

Reinforced Concrete columns: Reinforced with longituainal steel and $\frac{1}{4}$"round ties at 12" spacing.

Allowable Fc equals 450 lb./sq/ inch

n equal 15

Fs equals 18,000 lb./sq. inch

Fire protection of two inches of concrete covering all steel is required.

H beam columns: Allowable loadings taken from Steel Construction by A.I.S.C. Encased in concrete to provide protection against fire.

Floor slabs:-

Considered as slightly restrained beams. Mequals $wl^2/10$.

Main steel Fs equals 18,000 lb./sq. inch

Temperature steel As equal .002Xbd where b is 12" and d is the depth from the top of the slab to the center of the main steel.

s is the unit working stress of steel taken as 18000 lb. per square inch, M is the above moment, c is the distance in inches from the neutral axis to the outermost fiber, and I is the moment of inertia about the neutral axis. Check the shear. the allowable is 13,500 lb. per square inch.

Rafters:-

Considered as having three point suspension with the loads concentrated at the purlins. Compare the I of the member with the I required as with the purlins.

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Floor slabs:-

Considered as slightly restrained beams. Mequals $wl^2/10$.

Main steel Fs equals 18,000 lb./sq. inch

Temperature steel As equal .002Xbd where b is 12" and d is the depth from the top of the slab to the center of the main steel.

solid slabs cont.

Allowable shear in concrete equal .002Fc equal 40 lb. per square inch.

Bond equal 125 lb. per sq. inch.

Fire protection

slabs 5" thick ----2"

slabs 3" thick ----1½"

Terra cotta floor slabs:-

Figured as slightly restrained tee beams carrying the floor load equal to that from center line to center line of tees. Mequal $wl^2/10$.

weight	62.5 lb./sq. inch
main steel Fs	18,000lb./sq. inch.
fire protection	2 inches concrete
Shear allowable	40 lb./sq. inch
bond	125 lb./sq, inch

Floor beams:-

Built to act integrally with the columns and walls.

M equal $wl^2/12$

Main steel	Fs equal 18,000 lb./sq. inch
Fire protection	3" on bottom of beam
Shear allowable	40 lb./sq. inch
Bond	125 lb./sq. inch

Footings:-

Allowable earth pressure

Interior footings	4,000lb./sq, inch
Exterior footings	3,500lb./sq. inch

Fs equal 18,000lb./sq. inch steel both ways

Footings cont.

Shear in concrete	40 lb./sq. inch
Bond	125 lb./sq. inch

Punching shear was not designed for

General Notes:-

All columns to have two anchors 7/8X2'-0" unless otherwise noted.

Horizontal bars shall lap 40 diameters at splices and lapped for splice.

Provide 3--5/8"round bars over all openings in concrete walls unless otherwise noted.

Sag rods for purlins to be 5/8" round.

Diagonal bracing to be 7/8"round rods unless otherwise noted.

Purlins in general to be framed flush on top with supporting beams.

Provide bearing plates under all wall bearing beams. Allow 100 lb./sq. inch on masonry walls. Anchor with 2--4X3X¼L clips.

All columns resting on the third floor to have 2--¾"roundX1'--8" long anchor bolts unless otherwise called for.

Roof Purlins

It is quite evident that the purlins are entirely ample to take the loads applied upon them. The tabulated results seem to indicate that lighter sections could have been used in some cases, however, investigation of suitable standard listed in the steel handbooks has indicated that the most economical sections have been used. Purlin number 8 might possibly have been made of an 8" CBJ--10lb., but in consideration of the slight added cost of this member it was evidently thought better tobe on the safe side in this type of structure where many persons will be housed.

Purlin Table

No.	Size	Iprovided	Ineeded	Remarks
1.	6"CBJ-8.5#	14.8	14.7	lightest standard I sec-
2.	8"CBJ-10#	30.8	24.8	tion available yet ample
3.	10"CBJ-11.5#	51.9	34.9	"
4.	12"CBJ-14#	88.2	63.6	"
5.	6"Ch.-8.2#	13.3	7.5	"
6.	10"CBL-15#	81.8	67.2	"
7.	10"CBL-17#	81.8	67.2	"
8.	8"WF_-17#	56.4	26.6	might use 8"CBJ--10#

Sample Computations:-

Purlin no. 1 6"CBJ--8.5 lb. A--2.50 sq. inches

I--14.8 s--3" as from A.I.S.C. handbook.

Distance between rafters 13'--8"

Distance between purlins 3'--4"

Roof purlins cont.

$$\text{Load--}\ \frac{58\times3.3}{0.707}\ \text{plus}\ 8.5 = 279.5\ \text{lb./ ft.}$$

$$I = \frac{Mc}{s} = \frac{279.5\times\overline{13.7}^{2}\times12\times3}{8\times18{,}000} = 14.72$$

Shear:-

Web area = 6X3/16 or 1&1/8 sq. inches

$$v = \frac{13.7\times279.5\times16}{2\times1\tfrac{1}{8}} = 1{,}700\ \text{lb./sq. inch}$$

Rafters

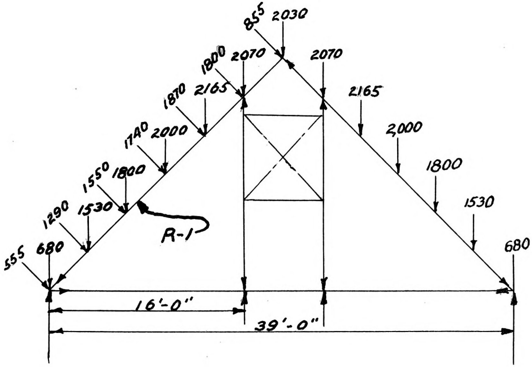
It is evident that the rafters have been selected so as to be of the lightest weight possible and still be on the side of safety. Rafter No. 6 has an I of 66.9 supplied where an I of 68.8 is indicated as being required. However, this member is anchored eight inches into the wall and the wall may be considered as resisting the added bending. Rafter No. 4 might have beenmade of a 25 lb. 12" WF beam, but due to the difficulty of theoretically analyzing the reactions in this rafter, a 30 lb.--14" WF beam, which is only five pounds heavier has been used.

Rafter Table

No.	Size	Max. Mom. ft. lb.	I had	I need	Remarks
1.	12"WF-25#	31200	183.4	142	compression&shear ok
2.	10"CBJ11.5#	12400	51.9	46.5	"
3.	10"WF-21#	25000	106.3	95.0	"
4.	14"WF-30#	32000	289.6	170.0	"
5.	12"CBJ 14#	18700	88.2	69.0	"
6.	10"Ch-15.3#	18340	66.9	68.8	wall takes some bend.

Rafter Sample Computations

R-1 12" WF-25lb. A--7.39 sq. in. I--183.4



Maximum Moment= 31,200 ft. lb.

$I = \frac{31.200X12X6}{18,000} = 142$ Have I of 183.4

Direct compression L/r is 65

Alowable compression equals 14,950 lb./sq. inch

$s = \frac{18,400}{7.39} = 2,500$lb./sq. inch

Shear $= \frac{8,100}{.24X12-4X.24} =$ 4,200lb./sq. in. OK

Columns Supporting the Roof

The main roof columns consist of H sections, framed to plates bolted onto the columns extending from the columns supporting the third floor. The exterior roof columns consist of the third floor columns extended up sixteen inches above the third floor line to which the rafters are framed. Dormer columns are built up of 2-4X3X$\frac{1}{4}$" angles back to back. All of the columns are fully ample to resist the stresses applied, however those supporting the fan platform and the stacks have been enlarged in the interest of safety.

Computation:

Column No. 92 6" H-15.5 lb./ft. I equal 30.1

Unsopported height 9 feet

Allowable vertical load from Steel Construction by A.I.S.C. is 65,000 pounds

Load present:

Roof	9,500
Column weight	300
Total	10,000 pounds

Possible moment due to horizontal thrust of the wind equals 13,500 ft. pounds

$$I = \frac{13,500X12X3}{18,000} = 29.8$$

I provided equals 30,1

H Beam Columns Supporting the Roof

No.	Size	Vert. comp. pounds	Allowable pounds	Max. I	Allowable
6	6X6-15.5#	2,300	72,000	11.3	30.1
7.	"	"	"	"	"
92.	"	14,400	65,000	28.3	"
93.	"	"	"	"	"
97.	"	"	""	"	"
98.	"	"	"	"	"
100.	"	"	"	"	"
103.	"	"	""	"	"
107.	"	"	"	"	"
108.	"	"	"	"	"
94.	6X6-20#	23,400	82,000	-- -	-----------
96.	"	"	"		
104.	"	"	"		
106.	"	"	"		
82.	6X6-15.5#	17,000	65,000	27.0	30.1
83.	"	"	"	"	"
90.	"	"	"	"	"
91.	"	"	"	"	"
87.	"	17,100	65,000	-----	----------
88.	"	"	"		
89.	"	"	"		
~~90.~~ 86.	"	"	"		
85.	"	"	"		
84.	"	"	"		

H Beam Columns Supporting the Roof

No.	Size	Vert. compr. pounds	Allowable pounds	Max. I	Allowable
83.	6X6-15.5#	17,100	65.000	------------------	
82.	"	"	"		
81.	"	"	"		
80.	"	"	"		
79.	"	"	"		
78.	"	"	"		
74.	"	"	"		
73.	"	"	"		
100.	"	"	" "		
101.	"	"	"		
11.	8X6½-24#	18,000	75,000	26.6	46.3
14.	"	"	"	"	"
21.	"	"	"	"	"
24.	"	"	"	"	"
33.	"	"	"	"	"
34.	"	"	"	"	"

Double Angle Columns Supporting Dormer Roof

No.	Size	Vert. compr.	Allowable	Max.I	Allowable
18.	4X3X¼	6,600#	30,200#	2.2	2.8

Columns No. 19, 26, 27, 30, 31, 36, 37, 40, and 41 are similar to column No. 18 in all respects.

Reinforced Concrete Columns

The minimum size reinforced concrete column allowed by the Joint Committee, 12"X12" with 4-5/8" round bars longituidinal steel and $\frac{1}{4}$" round ties at 12" spacing has been used wherever possible. The outer columns have also been designed to resist the moment set up by the action of the wind on the walls. Wherever it was necessary, the columns were increased in size to allow for added load. Columns. No. 8, 17, 19, 26, 31, 36, 21, 24, 33, 34, and 41 supporting the first floor are slightly overstressed, having an Fc of 500 lb. per square inch, but the wall may be considered as taking part of the load, and also if the concrete is considered as 2,500lb. concrete the allowed Fc is 560 lb. per square inch, so the columns mentioned are evidently satisfactory. Columns No. 28 and 39 are stressed to 520 lb. per square inch, however they also are exterior columns with the basement walls taking part of the load.

Column No. 47 was made a 12"X37" column rather than to make two adjacent 12"X12" columns with tile masonry between them. This was done in the interests of more simplified construction and economy of construction.

Many of the columns seem to be overdesigned. Perhaps there is a reason for doing this which this investigation has not brought to light or which is beyond, due to a lack of actual experience in design, the comprehension of the author.

Reinforced Concrete Columns

Third floor:

No.	Size "	Main Steel	Ties	Maximum load	Fc	Allowable
92.	12X12	4-5/8"rd.	¼"@12"	33,600	210	450
93.	"	"	"	"	"	"
94.	"	"	"	"	"	"
95.	"	"	"	"	"	"
96.	"	"	"	"	"	"
97.	"	"	"	"	"	"
98.	"	"	"	"	"	"
100.	"	"	"	"	"	"
101.	"	"	"	"	"	"
102.	"	"	"	"	"	"
103.	"	"	"	"	"	"
104.	"	"	"	"	"	"
105.	"	"	"	"	"	"
106.	"	"	"	"	"	"
107.	"	"	"	"	"	"
108.	"	"	"	"	"	"
77.	"	"	"	39,340	244	450
69.	"	"	"	"	"	"
99.	"	4-7/8"rd.	"	47,000	262	450
70.	"	"	"	"	"	"
3.	"	4-5/8"rd.	"	31,000	191	450
34.	"	"	"	"	"	"
4.	"	"	"	"	"	"
43.	"	"	"	"	"	"
5.	"	"	"	"	"	"

Reinforced Columns

Third floor

No.	Size "	Main Steel	Ties	Maximum load	Fc	Allowed
42.	12X12	4-5/8"rd.	¼"@12"	31,000	191	450
6.	"	"	"	"	"	"
41.	"	"	"	"	"	"
7.	"	"	"	"	"	"
40.	"	"	"	"	"	"
9.	"	"	"	"	"	"
16.	"	"	"	"	"	"
18.	"	"	"	"	"	"
27.	"	"	"	"	"	"
19.	"	"	"	"	"	"
26.	"	"	"	"	"	"
31.	"	"	"	"	"	"
36.	"	"	"	"	""	"
30.	"	"	"	"	"	"
37.	"	"	"	"	"	"
29.	"	"	"	"	"	"
38.	"	"	"	"	"	""
7.	"	"	"	58,250	360	450
17.	"	"	"	"	"	"
28.	"	"	"	"	"	"
39.	"	"	"	"	"	"
11.	"	"	"	22,100	136	450
14.	"	"	"	"	"	"
21.	"	"	"	"	"	"
24.	"	"	"	"	"	"

Reinforced Concrete Columns

Third floor:

NO.	Size in.	Main Steel	Ties	Maximum load	Fc #/sq.in.	Allowed
33.	12X12	4-5/8"rd.	$\frac{1}{4}$"rd@12"	22,100	136	450
34.	"	"	"	"	"	"
21.	$3\frac{1}{2}$"std. pipe			10,000#	Allowed	45,100#
23.	"	"		"	"	"

Second floor:

NO.	Size in.	Main Steel	Ties	Maximum load	Fc #/sq.in.	Allowed
78.	12X12	4-$\frac{3}{4}$"rd.	$\frac{1}{4}$"@12"	65,000	375	450
79.	"	"	"	"	"	"
80.	"	"	"	"	"	"
81.	"	"	"	"	"	" "
86.	"	"	"	"	"	"
87.	"	"	"	"	"	"
88.	"	"	"	"	"	"
89.	"	"	"	"	"	" "
82.	"	4-7/8"rd.	"	69,000	390	450
83.	"	"	"	"	"	"
90.	"	"	"	"	"	"
91.	"	"	"	"	"	"
6.	"	4-$\frac{3}{4}$"rd.	"	55,500	335	450
7.	"	"	"	" "	"	"
30.	"	"	"	"	"	"
37.	"	"	"	"	"	"
40.	"	"	"	"	"	"
41.	"	"	"	"	"	"
29.	"	"	"	"	"	"
9.	"	"	"	"	"	"

Reinforced Concrete Columns

No.	Size "	Main Steel	Ties	Maximum load #	Fc	Allowed lb./sq. in.
16.	12X12	4-¾"rd.	¼"@12"	55,500	335	450
10.	"	4-5/8"rd.	"	37.300	230	450
15.	"	"	"	"	"	"
20.	"	"	"	"	"	"
25.	"	"	"	"	"	"
32.	"	"	"	"	"	"
35.	"	"	"	"	"	"
8.	"	4-1"rd.	"	80,000	424	450
17.	"	"	"	"	"	"
21.	"	"	"	"	"	"
24.	"	"	"	"	"	"
33.	"	"	"	"	"	"
34.	"	"	"	"	"	"
28.	"	"	"	"	"	"
39.	"	"	"	"	"	"
18.	12X12	4-5/8"rd.	"	55,500	344	450
27.	"	"	"	"	"	"
38.	"	"	"	"	"	"
44.	"	"	"	33,200	206	450
45.	"	"	"	"	"	"
46.	"	"	"	"	"	"
48.	"	"	"	"	"	"
51.	"	"	"	"	"	"
52.	"	"	"	"	"	"
47.	12X37	6-¾"rd.	"	43,000	97	450
22.	3½"std pipe	load--18,600		allowed	45,100	
23.	"	" "	"	"	"	

Reinforced Concrete Columns

First floor

No.	Size "	Main Steel	Ties	Maximum load #	Fc	Allowed lb./sq. inch
1.	12x12	4-5/8"rd.	¼"rd@12"	55,700	220	450
2.	21x32	4-1"sq.	"	136,000	202	"
3.	21x28	"	"	125,000	203	"
4.	"	"	"	"	"	"
5.	21x20	4-7/8"rd.	"	91,500	202	450
6.	12x12	4-1"rd.	"	83,700	440	450
7.	"	"	"	"	"	"
9.	"	"	"	"	"	"
16.	"	"	"	"	"	"
18.	"	"	"	"	"	"
27.	"	"	"	"	"	"
29.	"	"	"	"	"	"
30.	"	"	"	"	"	"
34.	"	"	"	"	"	"
40.	"	"	"	"	"	"
38.	"	"	"	"	"	"
8.	"	4-11/8"sq.	"	107,000	500	450
17.	"	"	"	"	"	"
19.	"	"	"	"	"	"
26.	"	"	"	"	"	"
31.	"	"	"	"	"	"
36.	"	"	"	"	"	"
21.	"	"	"	"	"	"
24.	"	"	"	"	"	"

Reinforced Concrete Columns

First floor

No.	Size "	Main Steel	Ties	Maximum load #	Fc lb./sq. inch	Allowed
33.	12X12	4-9/8"rd.	¼"rd.@12"	107,000	500	450
34.	"	"	"	"	"	"
41.	"	"	"	"	"	"
10.	12X12	4-5/8"rd.	"	58,200	360	450
15.	"	"	"	"	"	"
12.	"	"	"	"	"	"
13.	"	"	"	"	"	"
44.	"	"	"	"	"	"
45.	"	"	"	"	"	"
46.	"	"	"	"	"	"
11.	12X16	4-¾"rd.	"	64,500	335	"
14.	"	"	"	"	"	"
20.	12X12	"	"	"	350	"
25.	"	"	"	"	"	"
32.	"	"	"	"	"	"
33.	"	"	"	"	"	"
28.	"	8-1"rd.	"	120,000	520	450
39.	"	"	"	"	"	"
41.	"	4-9/8"sq.	"	71,000	330	450
42.	14X14	4-1"sq.	"	99,500	395	450
43.	22X22	4-9/8"sq.	"	163,000	292	450
47.	12X37	6-¾"rd.	"	75,000	155	450
48.	12X12	4-7/8"rd.	"	70,000	400	450
49.	"	"	"	49,300	304	450
50.	"	"	"	"	"	"

Forst floor cont.

No.	Size "	Main Steel	Ties	Maximum load #	Fc	allowed lb./sq. in.
51.	12X12	4-5/8"rd	¼"rd.@12"	49,300	304	450
55.	"	"	"	"	"	"
56.	"	"	"	"	"	"
57.	"	"	"	"	"	"
58.	"	"	"	"	"	"
59.	"	"	"	"	"	"
60.	"	"	"	"	"	"
52.	"	4-7/8"rd.	"	53,400	300	450
53.	22X22	4-9/8"sq.	"	159,000	290	450
54.	"	"	"	"	"	"
61.	16X16	8-1"rd.	"	121,000	354	450
62.	"	"	"	"	"	"
65.	14X14	4-1"sq.	"	108,500	430	450
66.	"	"	"	"	"	"
67.	"	"	"	"	"	"
63.	"	"	"	"	"	"
64.	"	"	"	"	"	"
68.	"	"	"	"	"	"
69.	12X18	6θ1"sq.	"	146,200	485	450
70	12X12	4-5/8"rd.	"	49,300	304	450
71.	18X18	8-1"sq.	"	160,000	372	450
73.	"	"	"	"	"	"
74.	"	"	"	"	"	"
76.	"	"	"	"	"	"

First floor columns cont.

No.	Size "	Main Steel	Ties	Maximum load #	Fc lb./sq. inch	Allowed lb./sq. inch
72.	12X12	4-5/8"rd.	¼"rd.@12"	40,000	250	450
75.	"	"	"	"	"	"
77.	12X14	6-1" sq.	"	133,650	472	450
78.	12X16	4-9/8"sq.	"	101,300	470	450
82.	12X12	"	"	"	"	"
83.	"	"	"	"	"	"
90.	"	"	"	"	"	"
91.	"	"	"	"	"	"
84.	"	"	"	"	"	"
85.	"	"	"	"	"	"
79.	"	4-1"sq.	"	99,000	446	450
80.	"	"	"	"	"	"
81.	"	"	"	"	"	"
86.	"	"	"	"	"	"
87.	"	"	"	"	"	"
88.	"	"	"	"	"	"
89.	"	"	"	"	"	"

22. 3½"std. pipe load is 23,000lb. Allowed 45,100lb.

25. " " " " " " "

H Section Columns Supporting the Second Floor

For architectural purposes, many of the columns supporting the third floor have been offset from the under column and supported on steel beams which also serve as floor beams for the second floor. These offset columns set up an eccentricity whose moment is more economically resisted by the use of a steel H beam column to support the floor beam which in turn supports the upper column. It is also easier to frame a steel floor beam to the H section column than to a concrete column. It is also possible to save some on the total height of the structure in this manner, and therefore a great saving is made.

Loadings were checked with those listed as being allowable by the A.I.S.C. handbook, Steel Construction. Ample bearing plates have been provided for the columns to rest on.

The steel beams are encased in concrete for fire protection.

Columns No. 22 and 23 of 3½" standard pipe, concrete filled, are satisfactory to resist the loads applied and are economical.

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Columns No. 22 and 23 of 3½" standard pipe, concrete filled, are satisfactory to resist the loads applied and are economical.

Steel Columns Supporting the Second Floor

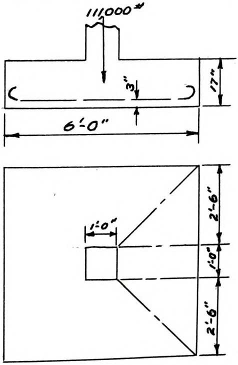
No.	Kind	Plate	Load lbs.	Allowed	Bearing on plate lb./sq.in.
61.	8H-31#	1½X16X16	64,000	132,000	212
62.	"	"	"	"	"
63.	"	1½X14X14	64,600	"	278
64.	"	"	"	"	"
65.	"	"	"	"	"
66.	"	"	"	"	"
67.	"	"	"	"	"
68.	"	"	"	"	"
71.	8H-48#	2X18X18	95,000	217,000	290
76.	"	"	"	"	"
73.	8H-40#	"	83,500	180,000	262
74.	"	"	"	"	"
1.	1L6X6X3/8	¾X8X8	11,300	14,900	177
2.	"	"	"	"	"
3.	12H-65#	2½X24X16	110,000	310,000	290
4.	"	"	"	"	"
5.	"	"	"	"	"
11.	8"H-31#	1½X12X12	43,500	137,000	300
12.	"	"	"	"	"
13.	"	"	"	"	"
14.	"	"	"	"	"
42.	12H-65#	2X16X16	76,330	310,000	300
43.	"	2X20X20	130,000	310,000	325
54.	"	"	"	"	"
53.	"	"	"	"	"

Footings

The allowable earth pressure for outer footings is 3,500 lb. per square foot. Footings No. 12, 13, 49, and 52 have and Ep of 3,800lb./square foot, but some of this load can be considered as being taken by the wall. The remainder of the footings are entirely adequate to care for the loads applied upon them. All footings were checked for shear, for the area of steel, and for bond in the steel and were found to be very satisfactory. The footings were first checked for earth pressure. Punching shear limitations are not required in the specifications, however, the author checked for this item and found that approximately half of the footings were adequately thick to come within the limitations set up by this specification.

Computation

Footing 5 6'-0"x6'-0"x17" 13-½"sq. bars



Gross earth pressure

$$Ep = \frac{111,000 \text{ plus } 36X17/12X150}{36} = 3,300 \text{lb./sq. foot}$$

Net earth pressure

$$Ep = \frac{111,000}{36} = 3,100 \text{lb./sq. foot}$$

Shear

$$v = \frac{(36-14.7)3,100}{\frac{7}{8}X14X4X46} = 29.4 \text{ lb./sq. inch}$$

Area of steel

$$As = \frac{(\overline{\frac{2.5}{2}}^2 X1 \text{ plus } \overline{2.5}^3 X.6)X3,100X12}{18,000X14X7/8} = 2.78 \text{ sq. inchws}$$

Bond

$$u = \frac{3,100X(36-1)}{4X2X13X14X7/8} = 85 \text{ lb. per sq. inch}$$

Punching shear

$$d = \frac{(36-1)X3,100}{4X12X12} = 18.8 \text{ inches}$$

No.	Size	Steel bars	GrossEp #/sq.'	Shear #/sq."	As have	As need	Bond #/sq."
2.	8'-6"X17'-0"	46-½"sq.	1,160	8.3	13	12.1	87
3.	"	"	"	"	"	"	"
4.	8'X8'X21"	18-½"sq.	2,220	20.4	4.5	2.8	59
5.	6'X6'X17"	13-½"sq.	3,300	29.4	3.25	2.8	85
11.	"	"	"	"	"	"	"
14.	"	"	"	"	"	"	"
18.	"	"	"	"	"	"	"
27.	"	"	"	"	"	"	"
29.	"	"	"	"	"	"	"
30.	"	"	"	"	"	"	"
37.	"	"	"	"	"	"	

Footings cont.

No.	Size	Steel bars	Gross Ep #/sq.in.	Shear #/sq."	have	As need	Bond #/sq.in.
40.	6'X6'X17"	13-½"sq.	3,300	29.4	3.25	2.8	85
63.	"	"	"	"	"	"	"
64.	"	"	"	"	"	"	"
65.	"	"	"	"	"	"	"
66.	"	"	"	"	"	"	"
68.	"	"	"	"	"	"	"
78.	"	"	"	"	"	"	"
84.	"	"	"	"	"	"	"
85.	"	"	"	"	"	"	"
6.	6'-4"X6'-4"X18"	14-½sq	2,920	25.6	3.5	2.7	72
7.	"	"	"	"	"	"	"
9.	"	"	"	"	"	"	"
16.	"	"	"	"	"	"	"
19.	"	"	"	"	"	"	"
26.	"	"	"	"	"	"	"
31.	"	"	"	"	"	"	"
36.	"	"	"	"	"	"	"
41.	"	"	"	"	"	"	"
67.	"	"	"	"	"	"	"
8.	7'X7'X19"	16-½"sq.	2,700	28.0	4.0	3.64	66
17.	"	"	"	"	"	"	"
39.	"	"	"	"	"	"	"
10.	4'-4"X4'-4"X14"	16-3/8rd	32,700	12.2	1.76	1.39	60
15.	"	"	"	"	"	"	"
44.	"	"	"	"	"	"	"

Footings cont.:-

NO.	Size	Steel bars	GrossEp #/sq."	Shear #/sq."	As have	need	Bond
12.	3'-8"X38-8"X12	18¼"rd.	3,800	16	0.9	0.9	46
13.	"	"	"	"	"	"	"
49.	"	"	"	"	"	"	"
50.	"	"	"	"	"	"	"
20.	5'X5'X15"	19-3/8"rd.	2,600	19	2.09	1.27	67
25.	"	"	"	"	"	"	"
32.	"	"	"	"	"	Q	"
35.	"	"	"	"	"	"	"
52.	"	"	"	"	"	"	"
21.	6'-8"X6'-8"X19"	15-½"sq.	3,200	32	3.75	1.85	85
24.	"	"	"	"	"	"	"
33.	"	"	"	"	"	"	"
34.	"	"	"	"	"	"	"
27.	"	"	"	"	"	"	"
42.	"	"	"	"	"	"	"
69.	"	"	"	"	"	"	"
77.	"	"	"	"	"	"	"
22.	3'X3'X12"	12-¼"rd.	3,620	0	0.60	0.41	105
23.	"	"	"	"	"	"	"
55.	"	"	"	"	"	"	"
56.	"	"	"	"	"	"	"
57.	"	"	"	"	"	"	"
58.	"	"	"	"	"	"	"
43.	8'-8"X8'-8"X22"	20-½"sq	2,600	23.2	5.0	3.24	66
53.	"	"	"	"	"	"	"

Footings cont.:-

No.	Size	Steel bars	GrossEp #/sq.'	Shear #/sq."	As have	As need	Bond
38.	5'-8"X5'-8"X17"	21-3/8rd	3,660	24.4	2.31	2.21	89
47.	"	"	"	"	"	"	"
48.	"	"	"	"	"	"	"
79.	"	"	"	"	"	"	"
80.	"	"	"	"	"	"	"
81.	"	"	"	"	"	"	"
82.	"	"	"	"	"	"	"
83.	"	"	"	"	"	"	"
90.	"	"	"	"	"	"	"
91.	"	"	"	"	"	"	"
87.	"	"	"	"	"	"	"
88.	"	"	"	"	"	"	"
89.	"	"	"	"	"	"	"
45.	4'-8"X4'-8"X15"	17-3/8"rd.	2,860	16.0	1.88	1.14	72
46.	"	"	"	"	"	"	"
51.	"	"	"	"	"	"	"
54.	8'-4"X8'-4"X21"	18-½"sq.	2.540	11.0	4.5	3.56	73
71.	"	"	"	"	"	"	"
59.	3'-4"X3'-4"X12"	15-¼"rd.	3,730	26.0	0.70	0.53	108
60.	"	"	"	"	"	"	"
72.	"	"	"	"	"	"	"
75.	"	"	"	"	"	"	"
61.	7'X7'X19"	16-½"sq.	3,120	38.0	4.00	2.30	75
62.	"	"	"	"	"	"	"
76.	"	"	"	"	"	"	"

Footings cont.:-

No.	Size	Steel bars	GrossEp #/sq.'	Shear #/sq."	As have	As need	Bond
73.	7'-8"X7'-8"X21"	17-½"sq	3,000	24	4.25	3.27	73
74.	"	"	"	"	"	"	"
86.	5'-4"X5'-4"X16"	20-3/8rd	3,700	26	2.2	2.12	94

Floor Slabs

The solid slabs were assumed to be twelve inch wide rectangular beams. They were checked for main steel area, bond, shear, and temperature steel area. In checking for steel area, the actual resisting moment was compared with bending moment on the slab. The solid slab floors were found to be entirely adequate.

The terra-cotta slabs are of 6&2 construction with five inch joists at seventeen inch on centers. The area of steel necessary was checked by comparing allowable and needed bending moments. The steel was checked for bond and the joists were considered as tee beams and were then checked for shear. These slabs were found to be entirely adequate and in most instances closely designed

The steel tile slabs are of 6&2 construction with five by eight inch joists at twenty-five inches on centers. They were cjecked in a manner similar to that used with the terra cotta slabs. They were all found to be adequate to resist the loads to be applied upon them.

Floor Slabs

Terra Cotta

No.	Maximum Moment '# proveded	needed	Shear #/sq. "	Bond #/sq. "
302.	2,200	1,940	31.1	56.5
303.	2,200	2,180	32.0	57.3
304.	2,670	2,650	33.9	49.5
305.	2,840	2,650	33.9	49.5
306.	4,200	4,100	21.4	109.0
201.	2,700	2,680	39.4	72.0
203.	4.200	3,600	39.2	57.0
204.	"	4,120	42.0	61.0
206.	2,200	2,180	37.0	57.3
*207.	2,750	2,700	36.5	74.2
208.	1,740	1,680	31.1	62.5
210.	2,200	2,150	33.0	60.0
*211.	1,580	1,280	30.0	44.0
*212.	2,750	2,300	34.0	68.2
213.	2,200	1,650	39.0	57.0
214.	1,740	1,250	32.0	58.0
*215.	2,750	1,650	31.0	73.0
*216.	2,200	1,250	33.0	78.0
218.	1,230	320	20.0	49.0

* 4&4 construction.

Floor slabs

Steel tile slabs:

No.	Maximum Moment '# Provided	Need	Shear #/sq."	Bond #/sq."
219.	~~2,700~~ 3,540	3,400	38.0	76.0
220.	1,575	1,500	39.0	55.0
221.	4,800	4,640	36.0	80.0

Solid slabs:

No.	Size	Maximum Moment '# Allowed	Have	Shear #/sq."	Bond #/sq."
301.	5"	7,100	3,570	11.3	77.0
307.	3"	4,500	2,130	12.5	85.0
202.	5"	670	515	11.3	77.0
205.	7"	2,700	1,160	12.2	57.0
209.	4"	560	230	10.6	110.0
217.	4"	560	182	10.6	110.0
222.	4"	560	409	12.9	124.0

Sample computation:

Solid slab S 202 5" thick with 3/8"rd.@8" centers and temperature steel 3/8"rd. @ 18" centers

Load:

Live 75#/sq.'

Dead 62.5#/sq.'

Total 137.5#/sq.'

$$\text{Max. } M = \frac{137.5 \times 5 \times 5 \times 12}{10 \times 12} = 430'\#$$

Max. Moment allowable As = 0.17sq. inches

$$M = \frac{.17 \times 18,000 \times 3 \times 7}{12 \times 8} = 670 \text{ ft. pounds}$$

Computaions cont.

Bond = $\frac{137.5 \times 2.5 \times 8 \times 8}{12 \times 1.18 \times 7 \times 3}$ = 74#/sq."

Shear = $\frac{137.5 \times 2.5 \times 8}{12 \times 7 \times 3}$ = 10.9#/sq."

Temperature steel

As = .002X12X3 = .072

Have $\frac{.11 \times 12}{18}$ = .073

Terra cotta slab:

S201 6&2 5"joist@17"O.C. Moin steel 1-½"rd BDC and 1-5/8"rd.

Load:

Live	50.0#/sq.'
Dead	62.5#/sq.'
Total	112.5#/sq.'

$\frac{112.5 \times 17}{12}$ = 160#/sq.' on joist

Maximum Moment

Have = $\frac{160 \times 13 \times 13 \times 13 \times 12}{10}$ = 2,700 "#

Allowed = $\frac{.51 \times 7 \times 18,000 \times 4}{8}$ = 2,700"#

Shear = $\frac{160 \times 6.5 \times 8}{7 \times 5 \times 6}$ = 39.4#/sq."

Bond = $\frac{160 \times 6.5 \times 8}{7 \times 4 \times 3.53}$ = 72#/sq."

Floor, Beams

The concrete floor beams are either rectangular of tee beams, the tees being full, left, or right sided tees as indicated in the beam list included with the structural plans. These beams were checked for area of stteel, stirrup spacing and for bond on the steel. The beams are apparently all entirely adequate, however, this author cannot comprehend the reason for designing so many different beams, which vary only slightly as to size, amount of steel, and placing of steel. Some of the stirrup spacing variations are also beyond the understanding of the author.

The steel beam floor beams used to support the second floor were used because of the desitability of providing a clear span over the dining hall and the elimination of all columns in the center of this hall. They were also used where for architectural reasons the columns supporting the third floor were placed eccentrically with those columns directly below them supporting the second floor. This eccentric placing of the columns sets up a large moment which is better resisted by the use of a steel I beam. These beams were checked by comparing the I provided from the steel handbook with that necessary to resist the bending moment. They are all entirely adequate to resist the moments and shears applied.

No

30

30

30

30

30

30

3

3

3

3

3

3

3

3

Table of Floor Beams

No.	Size "	Tee "	Main steel straight	Main steel bent	As sq" have	As sq" need	Bond #/sq"	Stirrups
301.	12X13	--	3-5/8rd	1-$\frac{3}{4}$rd	1.36	1.34	87	3/8"rd@5"
302.	12X20	23	2-1"sq	1-1"rd	2.78	1.18	63	" @7"
303.	"	19	2-1"rd	"	2.35	1.75	112	" @6"
304.	"	14	2-$\frac{3}{4}$"rd	1-$\frac{3}{4}$rd	1.33	0.71	80	" @7"
305.	12X14	--	2-5/8rd	2-5/8rd	o.92	0.85	125	" @6"
306.	12X20	19	2-1"rd	1-1rd	2.36	1.36	83	" @8"
307.	12X8	--	2-3/8rd	1-$\frac{1}{2}$rd	0.42	0.21	80	-------
308.	12X16	--	1-5/8rd 1-$\frac{3}{4}$rd	1-$\frac{3}{4}$"rd	1.19	1.06	114	3/8"@7"
309.	"	18	2-7/8rd	1-7/8rd	1.8	1.37	100	"
310.	"	16	2-$\frac{3}{4}$rd	1-7/8rd	1.48	1.28	103	"
311.	12X24	19	1-1"rd 1-1"sq	1-1"sq	2.78	2.42	126	"
312.	12X20	16	2-7/8rd	1-7/8rd	1.80	1.22	123	"
313.	"	21	1-1"rd 1-1"sq	1-7/8rd	1.38	0.76	128	"
314.	12X16	16	2-7/8rd	1-$\frac{3}{4}$rd	1.64	0.71	83	"
315.	12X26	19	2-1"sq	1-1"sq	3.00	2.00	110	3/8"@8"
316.	12X20	18	1-7/8rd 1-1"rd	1-1"rd	2.38	1.99	128	" @7"
317.	12X18	18	2-7/8rd	1-1"rd	1.98	1.40	112.5	"
318.	8X16	13	1-5/8rd 1-$\frac{3}{4}$"rd	1-$\frac{3}{4}$"rd	1.19	0.69	63	"
319.	12X12	--	2-$\frac{1}{2}$"rd	1-$\frac{1}{2}$"rd	0.59	0.43	92	--"---
320.	12X20	14	2-7/8rd	1-$\frac{3}{4}$"rd	1.64	1.18	93	3/8"@9"
321.	12X22	18	2-1"rd	1-1"sq	2.57	1.30	107	" @7"
322.	12X20	16	1-7/8rd 1-1"rd	1-7/8rd	1.98	1.60	85	" @9"
323.	12X10	--	2-5/8rd	1-$\frac{1}{2}$"rd	0.81	0.35	64	-------
324.	8X18	--	"	1-5/8rd	0.92	0.48	70	--------
325.	"	12	1-5/8rd 1-$\frac{3}{4}$"rd	1-$\frac{3}{4}$"rd	1.19	0.65	80	3/8"@8"

Table of Floor Beams

No.	Size "	Tee "	Main steel straight	Main steel bent	As sq" have	As sq" need	Bond #/sq"	Stirrups
301.	12X13	--	3-5/8rd	1-¾rd	1.36	1.34	87	3/8"rd@5"
302.	12X20	23	2-1"sq	1-1"rd	2.78	1.18	63	" @7"
303.	"	19	2-1"rd	"	2.35	1.75	112	" @6"
304.	"	14	2-¾"rd	1-¾rd	1.33	0.71	80	" @7"
305.	12X14	--	2-5/8rd	2-5/8rd	o.92	0.85	125	" @6"
306.	12X20	19	2-1"rd	1-1rd	2.36	1.36	83	" @8"
307.	12X8	--	2-3/8rd	1-½rd	0.42	0.21	80	-------
308.	12X16	--	1-5/8rd 1-¾rd	1-¾"rd	1.19	1.06	114	3/8"@7"
309.	"	18	2-7/8rd	1-7/8rd	1.8	1.37	100	"
310.	"	16	2-¾rd	1-7/8rd	1.48	1.28	103	"
311.	12X24	19	1-1"rd 1-1"sq	1-1"sq	2.78	2.42	126	"
312.	12X20	16	2-7/8rd	1-7/8rd	1.80	1.22	123	"
313.	"	21	1-1"rd 1-1"sq	1-7/8rd	1.38	0.76	128	"
314.	12X16	16	2-7/8rd	1-¾rd	1.64	0.71	83	"
315.	12X26	19	2-1"sq	1-1"sq	3.00	2.00	110	3/8"@8"
316.	12X20	18	1-7/8rd 1-1"rd	1-1"rd	2.38	1.99	128	" @7"
317.	12X18	18	2-7/8rd	1-1"rd	1.98	1.40	112.5	"
318.	8X16	13	1-5/8rd 1-¾"rd	1-¾"rd	1.19	0.69	63	"
319.	12X12	--	2-½"rd	1-½"rd	0.59	0.43	92	--"---
320.	12X20	14	2-7/8rd	1-¾"rd	1.64	1.18	93	3/8"@9"
321.	12X22	18	2-1"rd	1-1"sq	2.57	1.30	107	" @7"
322.	12X20	16	1-7/8rd 1-1"rd	1-7/8rd	1.98	1.60	85	" @9"
323.	12X10	--	2-5/8rd	1-½"rd	0.81	0.35	64	-------
324.	8X18	--	"	1-5/8rd	0.92	0.48	70	--------
325.	"	12	1-5/8rd 1-¾"rd	1-¾"rd	1.19	0.65	80	3/8"@8"

Floor beams cont.:

No.	Size "	Tee "	Main steel straight	bent	As sq." have	need	Bond #/sq."	Stirrups
326.	8X15	20	1-7/8"rd 1-1"rd	1-1"rd	2.17	1.04	69	3/8"rd@5"
327.	12X18	21	"	"	"	1.31	90	"@7"
328.	"	18	2-7/8"rd	1-7/8"rd	1.80	0.79	86	"
329.	8X18	21	1-5/8"rd 1-¾"rd	1-¾"rd	1.19	0.45	76	"
330.	12X33.5"		2-1"rd	1-1"rd	2.36	0.78	43	3/8"rd@9"
331.	8X18	21	2-¾"rd	1-¾"rd	1.33	0.58	73	" @7"
332.	"	--	2-½"rd	1-½"rd	0.59	0.32	67	" @8"
334.	12X14	17	2-¾"rd	1-¾"rd	1.33	1.18	125	" @6"
335.	8X18	21	1-5/8"rd 1-¾"rd	1-¾"rd	1.19	0.93	104	" @7"
336.	"	12	"	"	"	"	"	" @6.5"
337.	"	21	1-½"rd 1-5/8"rd	1-5/8"rd	0.80	0.69	113	" @8"
338.	"	--	2-5/8"rd	"	00.92	0.84	81	" @7"
340.	8X28	--	2-½"rd	1-½"rd	0.59	0.09	20	------
341.	8X26	--	"	"	"	"	"	-----
343.	12X16	21	2-7/8"rd	1-1"rd	1.98	1.05	122	3/8"@5"
344.	6X16	--	2-½"rd	1-½"rd	0.59	0.15	79	-------
201.	12X14	16	2-¾"rd	2-½"sq	1.38	1.20	120	3/8"rd@6"
202.	12X12	19	"	"	"	1.40	126	" @5"
203.	"	14	2-½"sq	2-½"rd	0.89	0.54	130	" @7"
204.	8X18	10	2-¾"rd	1-¾"rd	1.33	0.59	51	------
205.	12X16	21	2-1"rd	2-7/8"rd	2.78	2.79	124	3/8"rd@5"
206.	12X10	18	2-½"sq	2-½"sq	1.00	0.39	50	-------
207	12X16	16	2-¾"rd	2-5/8"rd	1.49	1.10	75.5	-------
208.	12X20	21	2-1"rd	2-7/8"rd	2.97	1.17	57	3/8"rd@5"
209.	12X14	18	2-¾"rd	2-5/8"rd	1.49	1.10	101	"
210.	12X12	16	2-5/8"rd	2-½"sq.	1.11	0.86	70	3/8"rd@6"

Flloor beams cont.:

No.	Size "	Tee "	Main steel straight	Main steel bent	As have	sq." need	Bond #/sq."	Stirrups
326.	8X15	20	1-7/8"rd 1-1"rd	1-1"rd	2.17	1.04	69	3/8"rd@5"
327.	12X18	21	"	"	"	1.31	90	"@7"
328.	"	18	2-7/8"rd	1-7/8"rd	1.80	0.79	86	"
329.	8X18	21	1-5/8"rd 1-¾"rd	1-¾"rd	1.19	0.45	76	"
330.	12X33.5	"	2-1"rd	1-1"rd	2.36	0.78	43	3/8"rd@9"
331.	8X18	21	2-¾"rd	1-¾"rd	1.33	0.58	73	" @7"
332.	"	--	2-½"rd	1-½"rd	0.59	0.32	67	" @8"
334.	12X14	17	2-¾"rd	1-¾"rd	1.33	1.18	125	" @6"
335.	8X18	21	1-5/8"rd 1-¾"rd	1-¾"rd	1.19	0.93	104	" @7"
336.	"	12	"	"	"	"	"	" @6.5"
337.	"	21	1-½"rd 1-5/8"rd	1-5/8"rd	0.80	0.69	113	" @8"
338.	"	--	2-5/8"rd	"	00.92	0.84	81	" @7"
340.	8X28	--	2-½"rd	1-½"rd	0.59	0.09	20	------
341.	8X26	--	"	"	"	"	"	-----
343.	12X16	21	2-7/8"rd	1-1"rd	1.98	1.05	122	3/8"@5"
344.	6X16	--	2-½"rd	1-½"rd	0.59	0.15	79	-------
201.	12X14	16	2-¾"rd	2-½"sq	1.38	1.20	120	3/8"rd@6"
202.	12X12	19	"	"	"	1.40	126	" @5"
203.	"	14	2-½"sq	2-½"rd	0.89	0.54	130	" @7"
204.	8X18	10	2-¾"rd	1-¾"rd	1.33	0.59	51	------
205.	12X16	21	2-1"rd	2-7/8"rd	2.78	2.79	124	3/8"rd@5"
206.	12X10	18	2-½"sq	2-½"sq	1.00	0.39	50	-------
207	12X16	16	2-¾"rd	2-5/8"rd	1.49	1.10	75.5	-------
208.	12X20	21	2-1"rd	2-7/8"rd	2.97	1.17	57	3/8"rd@5"
209.	12X14	18	2-¾"rd	2-5/8"rd	1.49	1.10	101	"
210.	12X12	16	2-5/8"rd	2-½"sq.	1.11	0.86	70	3/8"rd@6"

Floor beams cont.:

No.	Size	Tee	Main Steel straight	bent	As sq." have	need	Bond #/sq."	Stirrups
211.	12X18	25	2-1"rd	2-7/8"rd	2.77	1.69	70	3/8"rd@5"
212.	12X12	19	2-¾"rd	2-½"sq	1.38	1.10	104	---------
213.	12X14	29	2-7/8"rd	2-7/8"rd	2.41	2.22	126	3/8"rd@7"
214.	12X16	21	"	2-¾"rd	2.08	0.94	72	" @6"
215.	7X18	15	"	1-¾"rd	1.64	0.88	77	" @7"
216.	8X18	11	2-¾"rd	1-5/8"rd	1.19	0.92	83	"
217.	"	10	2-5/8"rd	"	0.92	0.72	75	¼"rd@9"
218.	"	--	2-½"sq.	1-5/8"rd	0.81	0.77	83	3/8"rd@9"
219.	"	--	2-½"rd.	1-½"sq.	0.64	0.47	90	" @12"
220.	"	10	2-5/8"rd	1-¾"rd.	1.05	0.77	90	"
221.	12X16	--	2-½"rd.	1-½"sq.	0.64	0.47 0.56	104	"
222.	8X18	--	2-½"sq.	1-½"sq.	0.75	0.31	58	"
223.	"	--	2-5/8"rd	"	0.86	0.59	60	"
224.	"	10	"	1-¾"rd.	1.05	0.92	110	¼"rd@8"
225.	"	--	2-½"rd.	1-½"rd.	0.59	0.31	74	" @7"
226.	12X12	20	2-¾2rd.	2-½"sq.	1.38	1.34	116	3/8"rd@6"
227.	8X18	--	2-½"sqtop,	2-½"rd bpt	0.50 0.39	0.17 0.14	30	-------
228.	12X18	18	2-7/8"rd.	1-7/8"rd.	1.80	0.79	86	3/8"rd@6"
229.	8X28	--	2-¾"rd.	1-5/8"rd.	1.19	0.67	58	" @9"
230.	8X18	--	2-½"rd.	1-½"rd.	0.59	0.25	48	-------
231.	"	--	"	"	"	0.31	73	¼"rd@8"
232.	"	--	2-½"sq.	"	0.70	0.59	68	3/8"rd@10"
233.	"	--	"	1-½"sq.	0.75	0.59	63	"
234.	"	10	2-5/8"rd	1-5/8"rd	0.92	0.45	65	"
236.	12X14	26	2-7/8"rd	2-¾"rd.	2.08	1.27	94	3/8"rd@5.5"
237.	12X25	22	2-1"rd.	2-1"rd.	3.14	2.79	84	" @10"

Floor

No.

238.

239.

240

241.

242.

244.

243.

245.

246.

Ste

No.

No.

I p

36'

18'

18'

8'

30

18

12

12

16

Floor beams cont.:

No.	Size	Tee	Main Steel straight	Main Steel bent	As sq." have	As sq." need	Bond #/sq"	Stirrups
238.	14X26	20	2-1"sq.	2-1"sq.	4.00	2.81	60	$\frac{1}{2}$"rd@7"
239.	8X18	13	2-$\frac{3}{4}$"rd.	1-7/8"rd.	1.48	0.74	76	3/8"@7"
240	8X35	--	1-$\frac{1}{2}$"sq.	1-$\frac{1}{2}$"sq.	0.50	0.11	34	-------
241.	8X35	--	1-$\frac{1}{2}$"rd.	1-$\frac{1}{2}$"rd.	0.39	0.11	41	--------
242.	"	--	"	"	"	"	"	--------
244.	"	--	"	"	"	"	"	----- --
243.	"	--	1-5/8"rd.	1-5/8"rd.	0.61	0.38	67	$\frac{1}{4}$"rd@8"
245.	"	--	2-$\frac{3}{4}$"rd/	1-7/8"rd.	1.48	0.59	41	3/8"@12"
246.	8X18	16	2-7/8"rd.	"	1.80	0.56	55	3/8"@6"

Steel floor beams

No. 333 14"WF-58# I required-250 I proveded-597.9 v-1,370

No. 342. 12"WF-25# plus 12X5/16"plate I required- 318.4

I provided--298; shear is low.

36"WF-194# I required--11,000 I provided ---12,103.4

18"WF-124# I required-- 1,412.5 I provided-- 2,227

18"WF-96# I required-- 1,412.5 I provided-- 1,647.7

8"WF-19# I requirded-- 45.5 I provided--64.7

30"WF-180# I required-- 463 I provided--585.6

18"WF-85# I required--686 I provided--1,429.9

12"CBL_16.5# I required-- 78.3 I provided-- 105.3

12"WF-32# I required-- 180 I provided--246.8

16"WF-78# I reqmired--635 I provided--1,042.6

Computation of Floor Beam

Reinforced concrete beam:

B-224 8X18-10"T 2-5/8"rd Hook 1-$\frac{3}{4}$"rd. BDC

$\frac{1}{4}$"rd. stirrups @8"

Load:

Live	50#/sq.'
Dead	62.5#/sq.'
Total	112.5#/sq.'

112.5X6.25 plus 163 equal 930 #/lineal foot

Maximum Moment $= \frac{930X15X15X12}{12} =$ 209,000"#

As $= \frac{209,000X8}{7X18,000X14.5} =$ 0.92sq. inches

Have As of 1.05 sq. inches

Bond$= \frac{930X7.5X8}{7X14.5X6.29} =$ 110lb./sq. inch Allowed 125 lb./sq."

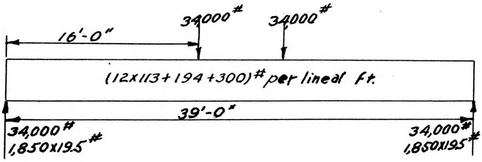
Shear $= \frac{930X7.5X8}{7X14.5X8} =$ 61lb./sq. inch

Stirrup spacing $= \frac{0.10X18,000}{8(61-40)} =$ 10.6 inches

$\frac{1}{4}$"rd. stirrups at 8" OK

Steel floor beam:

36"WF-194# I = 12,103.4



Steel floor beam computation cont.:

Maximum moment $= \frac{1,850 X 39 X 39 X 12}{8}$ plus 34,000X16X12

$= 10,760,000$ inch pounds

$I = \frac{Mc}{s} = \frac{10,760,000 X 18}{18,0000} = 10,760$

Have I of 12,103.4

Shear $= \frac{3,6000 \text{ plus } 34,100}{36 X 0.77} = 2,500$ lb./sq. inch OK

Pocket has: 3 Plans

114
439
THS
Plan 1