T H E S I S

California Institute of Technology
Pasadena, California.
Department of Civil Engineering

June 12, 1924.

INVESTIGATION OF CONCRETE FLOOR SYSTEMS

by

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STATEMENT OF THESIS PROBLEM

The problem consists of investigating a series of floor systems and an attempt to determine the most economical system under the following conditions:

60 feet across the end.

Indefinite number of panels but only computing the first two panels.

Consider the system as the sixth floor.

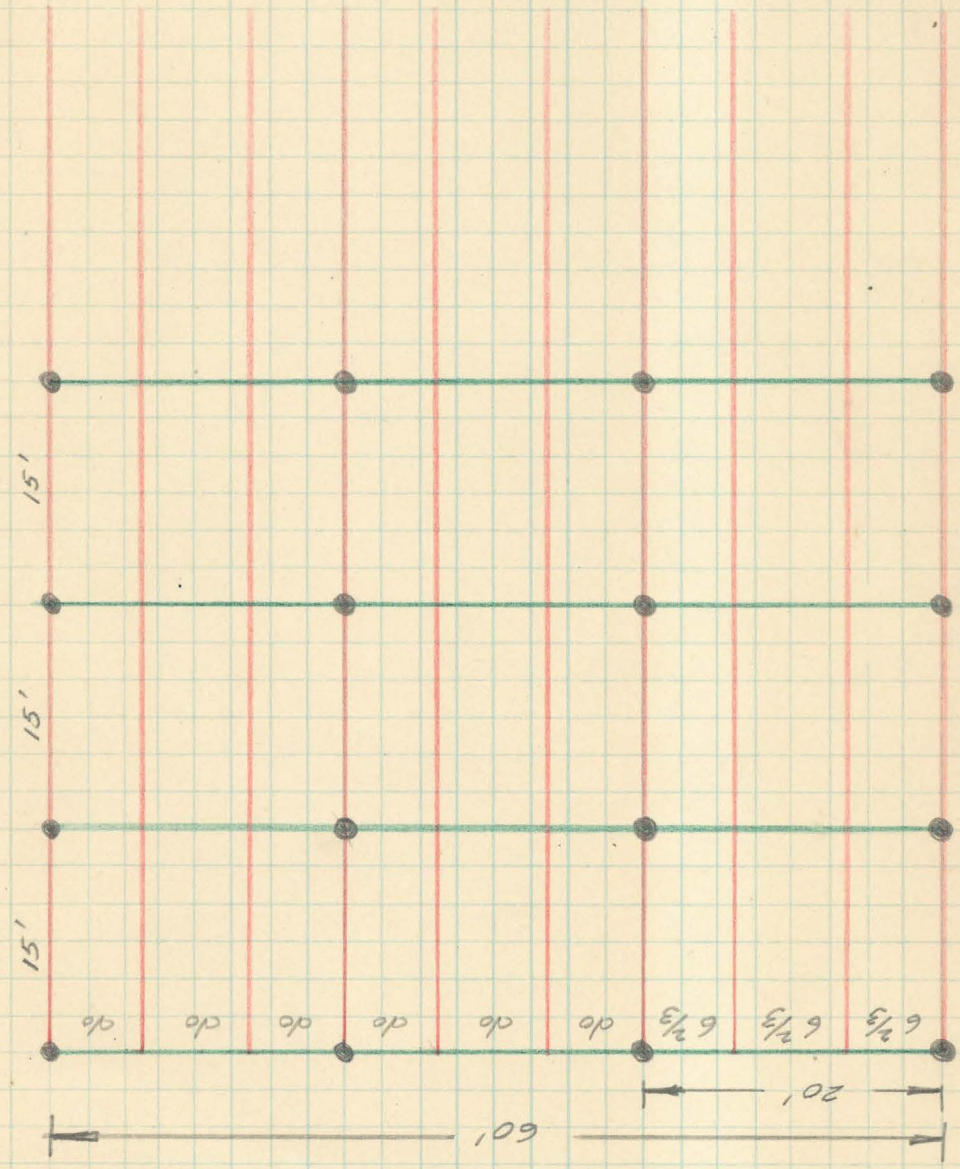
Calculate the columns down to the first floor

Joint Committee Recommendations

Making comparative plat using volume of concrete or steel per square foot of floor surface area.

SYSTEM NO. 1

SYSTEM NO. 1



END SLAB

Live Load = 100 #/□'
Dead Load = 50 #/□'
Total 150 #□'

Moment at Center –
$\frac{1}{10} \times 150 \times \left(\frac{20}{3}\right)^2 \times 12 = 8000$ in. lbs.

$d^2 = \frac{8000}{.0077 \times 16000 \times .874 \times 12} = 6.2$ □"

Negative Moment
Bend ½ bars over each support.

d d = 2.49" Say 2.5"

Take ¾" concrete below steel ∴ total depth = 2.5 + .75 = 3.25"

A_s Area of steel / ft. of breadth = pbd = .0077 × 12 × 2.5 = .231 □"
Use 4 - ¼" sq Area (1) = .062 □", (4) = .25 □"

Spacing – $\frac{.062}{.231} \times 12 = 3$" on centers

Check on dead load – 3.25 × 12 × 1.04 = 41 #/□' ∴ O.K.
∴ Total = 100 + 41 = 141 #/□'

SHEAR Shear at end / ft. of breadth = $(6\frac{2}{3}) \times \frac{1}{2} \times 150 = 500$ #
Allowable Shear = 40 × 12 × 2.5 = 1200 #
∴ No web reinforcement needed.

Mineo #1

END FLOOR BEAM

Unif. load / ft. = 940 # Add 60# for Stem Total = 1000 #

$V = \frac{15 \times 1000}{2} = 7500$ #

$b'd = \frac{7500}{105} = 71.4$ □" try b' = 8", d = 12"

Area = 96 □" Stem wt = 84 #

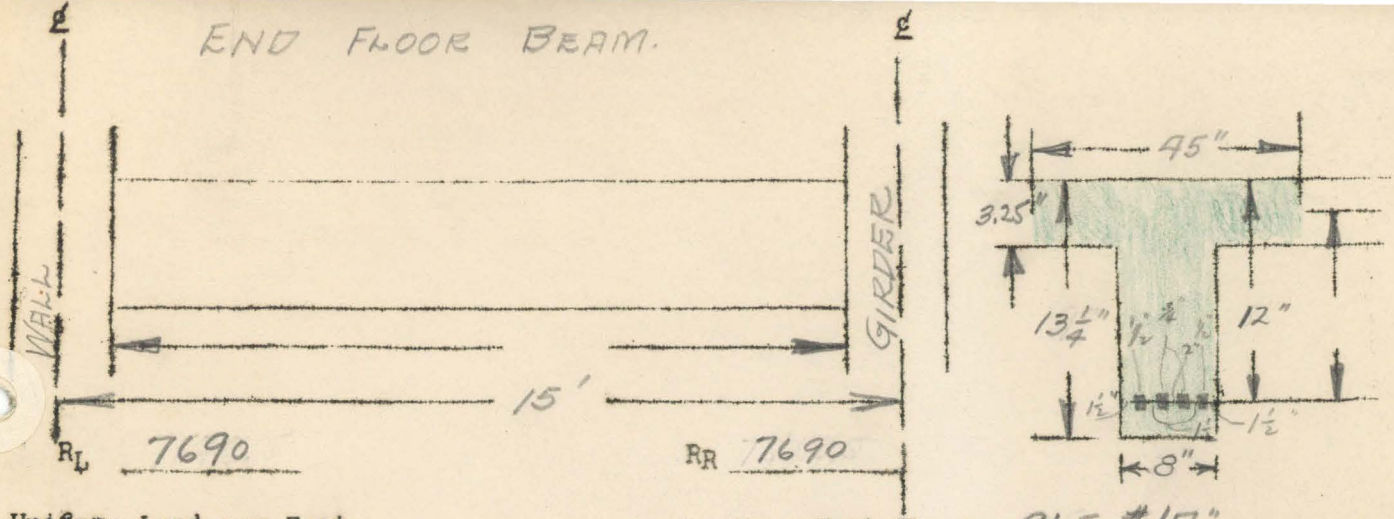
Check $V = \frac{15 \times 1024}{2} = 7690$ #

$b'd = \frac{7690}{105} = 73.2$ □" ∴ O.K.

Moment = $\frac{1}{10} \times 1024 \times (15)^2 \times 12 = 276{,}500$ in-lbs

$v = \frac{7690 \times 8}{7 \times 8 \times 12} = 91.5$ #/□"

END FLOOR BEAM.



Uniform Load per Foot
Slab $6\frac{2}{3} \times 141$ = 940
Stem $10 \times 8 \times 1.04$ = 84

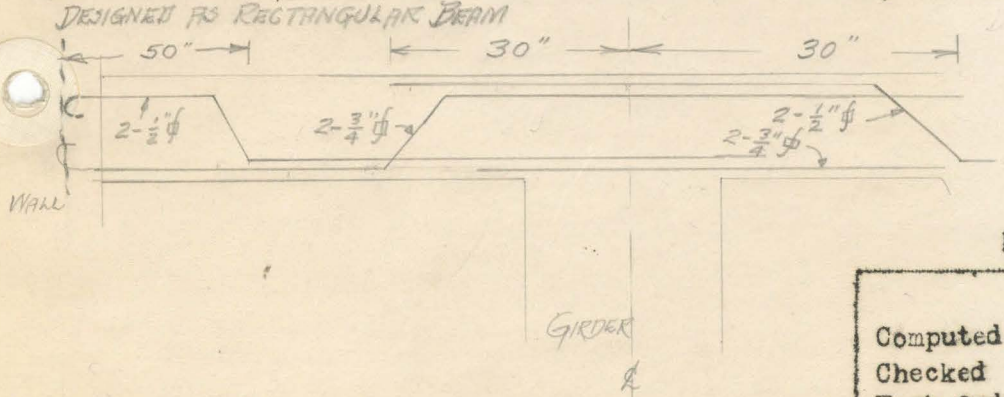
Max. Unit Shear = 91.5 #10"
Stirrups No = 4
l' = 51"
Spacing = 5 - 17½ - 31 - 45½

Total Unif.Load = 15380 = 15 x 1024
Conc. Loads =
Total Load = 15380
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$
$d' = 1.2"$

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/10	1/20
M = 276,500	"#	M at ℄ of support	276,500 "#	138,250 "#
M/bd2 = M/45x(12)² = 42.7		M at face support	"#	"#
b = 45	"	M/bd²	M/8x(12)² = 240	M/8x(12)² = 120
d = 12	"	Steel top	1.65 sq."	sq."
t/d = 3.25/12 = .271		p	.0172	
fc = 365	#/sq."	p'	.0138	
jd = .915x12 = 10.98	"	M/bd² allowable	133.5	133.5
As = .0029x45x12 = 1.57	sq."	f'steel	8550 #/sq."	#/sq."
Steel = 2-⅞"ϕ + 2-¾"ϕ = 1.63	sq."	Length to develop	16 "	"
		Bond Stress	120 #/sq."	#/sq."
p = .0029 K = .25		Steel bottom	1.33 sq."	sq."

DESIGNED AS RECTANGULAR BEAM



MARK B-6-END

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MIMEO #1

Slab 2nd panel

Live load = 100 #/□'
Dead " = 50 #/□'
Total = 150 #/□'

Moment Coef $\frac{1}{12}$ at center
Hool + Whitney — Pg. 9
$d = 2\frac{1}{4}$" add $\frac{3}{4}$"
Total depth = 3"

$A_s = pbd = .0077 \times 12 \times 2.25 = .208$ □"
Use $\frac{1}{4}$" ϕ spaced $3\frac{1}{2}$" c. on c.

Negative Moment
$A_s = .208$
∴ Bend $\frac{1}{2}$ of the bars over each support

M coef. $\frac{1}{10}$ at support
$f_c = 750$
$d = 2\frac{1}{4}$"

Check on dead load — $3 \times 12 \times 1.04 = 38$ #/□'
∴ Total = 138 #/□'

Shear / ft. of breadth = $150 \times 6\frac{2}{3} \times \frac{1}{2} = 500$ #
Allowable Shear = $40 \times 12 \times 2\frac{1}{4} = 1080$ #
∴ No web reinforcement needed.

MIMEO #2

Unif load/ft. = 920 # Add 80 # for stem Total = 1000 #

$V = \frac{15 \times 1000}{2} = 7500$ # $b'd = \frac{7500}{105} = 71.4$ □"

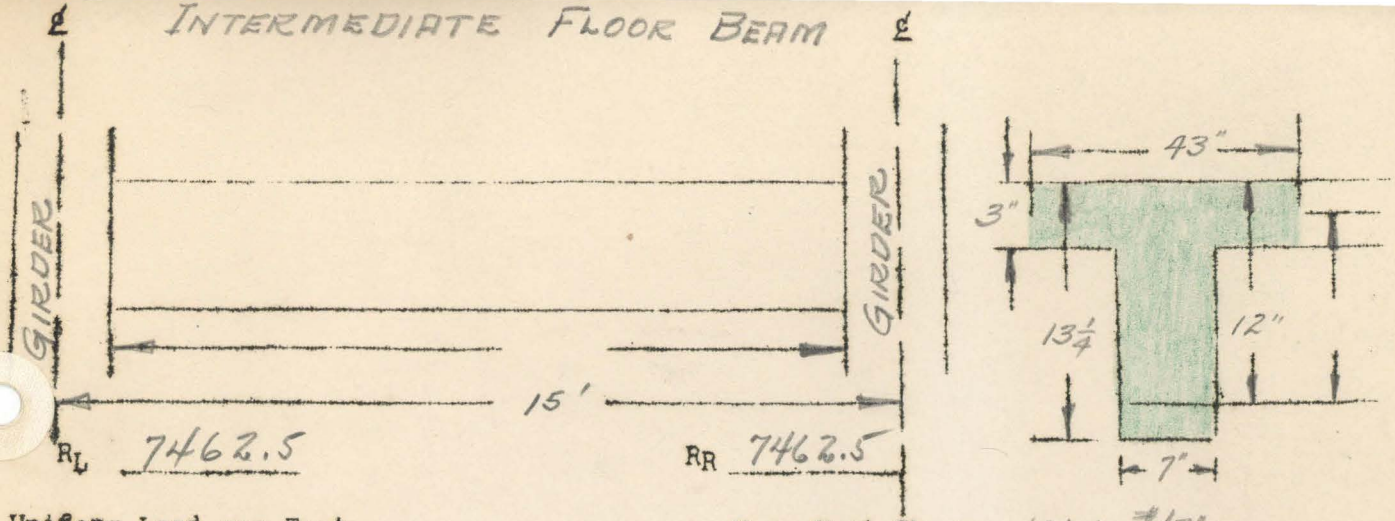
Try $b' = 7$ $d = 12$" Area = 77 □"

$M_{\frac{1}{10}} = \frac{1}{10} 995 \times (15)^2 \times 12 = 269{,}000$ in.-lbs.

$M_{\frac{1}{12}} = \frac{1}{12} 995 \times (15)^2 \times 12 = 224{,}000$ in.-lbs.

$v = \frac{14925 \times 8}{2 \times 7 \times 7 \times 12} = 101.6$ #/□"

INTERMEDIATE FLOOR BEAM



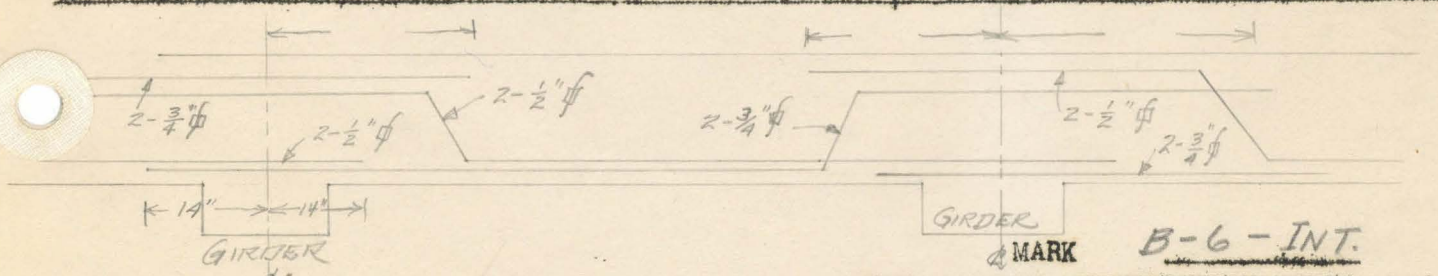
R_L 7462.5 R_R 7462.5

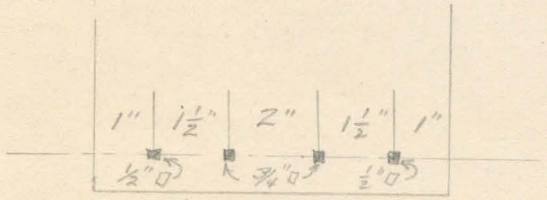
Uniform Load per Foot
Slab 138 × 6 2/3 = 920
Stem 10¼ × 7 × 1.04 = 75
Total Unif.Load= 14925 = 15 x 995
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear= 101.6 #/□"
Stirrups No = 4
1' = 55"
Spacing = 5¼ - 18 - 31 - 45¾

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/12	M Coef.	1/12	1/10
M = 224,000 "#	M at ℄ of support	224,000 "#	269,000 "#
M/bd2 = M/43x(12)² = 36.2	M at face support	"#	"#
p = 43 "	M/bd²	M/7x(12)² = 222	M/7x(12)² = 267
d = 12 "	Steel top	1.33 sq."	1.6 sq."
t/d = 3/12 = .25	p	.0158	.019
fo = 340 #/sq."	p'	.0115	.0175
jd = .92x12 = 11.04 "	M/bd² allowable	133.5	133.5
As = .0025 x 43x12 = 1.29 sq."	f'steel	8450 #/sq."	8500 #/sq."
Steel = 2-3¾" ⌀ = 1.63 sq."	Length to develop	14 "	14 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0025	Steel bottom	.965 sq."	1.47 sq."





Steel at Center

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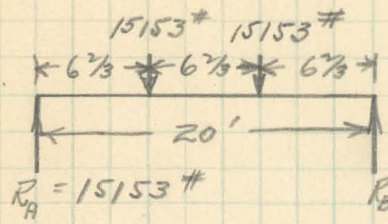
MIMEO #2

MIMEO #3



$M = 15153 \times 6\frac{2}{3} \times 12 = 1{,}213{,}000$ in.#

$M_{\frac{1}{10}} = 1{,}213{,}000 \frac{8}{10} = 970{,}000$ in-lbs

$M_{\frac{1}{20}} = 485{,}000$ in-lbs.

Assume wt. of Girder stem = 300#/ft.

$M_{\frac{1}{10}} = \frac{1}{10} 300 \times (20)^2 \times 12 = 144{,}000$ in-lbs.

$M_{\frac{1}{20}} = 72{,}000$ in-lbs.

Conc Load Shear = 15153
Unif " " = 3000
Total = 18153 #

$b'd = \frac{18153}{105} = 173$ □"

Try $b' = 12"$ $d = 18"$
Area = 12 × 18 = 216 □"

Wt. of stem = 212 #

Total $M_{\frac{1}{10}} = 1{,}114{,}000$ in-lbs

Total $M_{\frac{1}{20}} = 557{,}000$ in.-lbs.

Unif Moments Recomputed ! $M_{\frac{1}{10}} = 101{,}800$ in.-lbs

$M_{\frac{1}{20}} = 50{,}900$ in-lbs.

Super Code →

Total : $M_{\frac{1}{10}} = 1{,}071{,}800$ in-lbs ~~Superseded~~

$M_{\frac{1}{20}} = 535{,}900$ in.-lbs.

Unif Moment Recomputed for $b = 10"$ $d = 20"$ Area = 200

Wt. of Stem = 198#

Total $M_{\frac{1}{10}} = 1{,}065{,}000$ in-lbs

$M_{\frac{1}{20}} = 532{,}500$ in-lbs

$M_{\frac{1}{10}} = 95{,}000$ in.-lbs.

$M_{\frac{1}{20}} = 47{,}500$ in.-lbs.

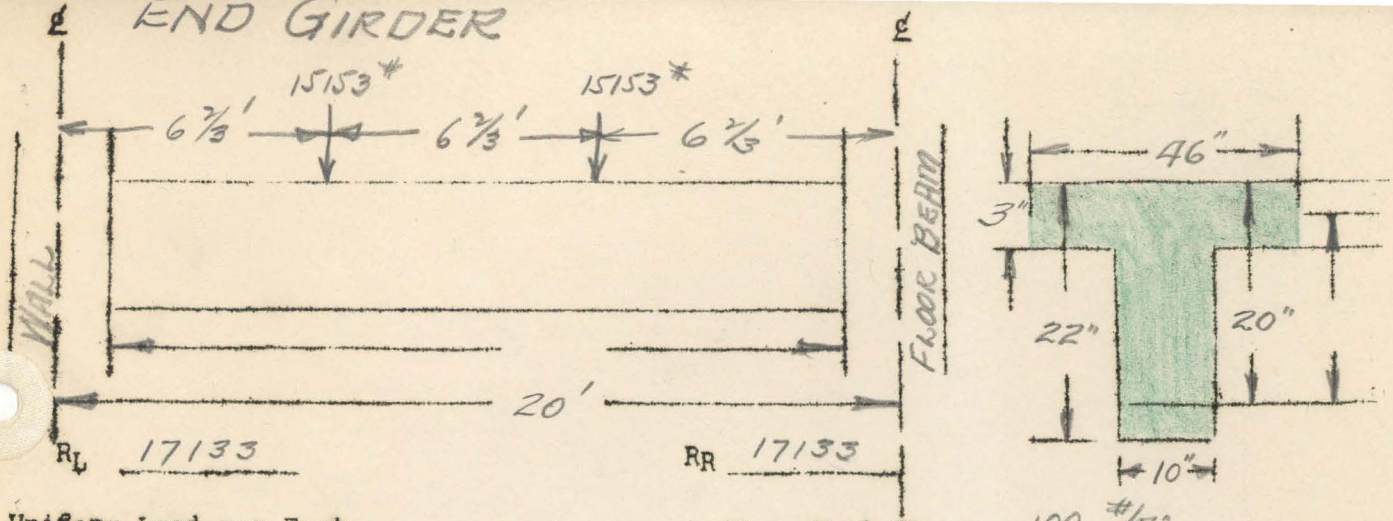
MIMEO #4

Use same dimensions as determined on MIMEO #3

$M_{\frac{1}{12}}$ (unif) $= \frac{1}{12} \times 198 \times (20)^2 \times 12 = 79{,}300$ in.-lbs.

$M_{\frac{1}{12}}$ (Conc.) $= 1{,}213{,}000 \times \frac{8}{12} = 810{,}000$ in-lbs

Total $M_{\frac{1}{12}} = 889{,}300$ in.-lbs.



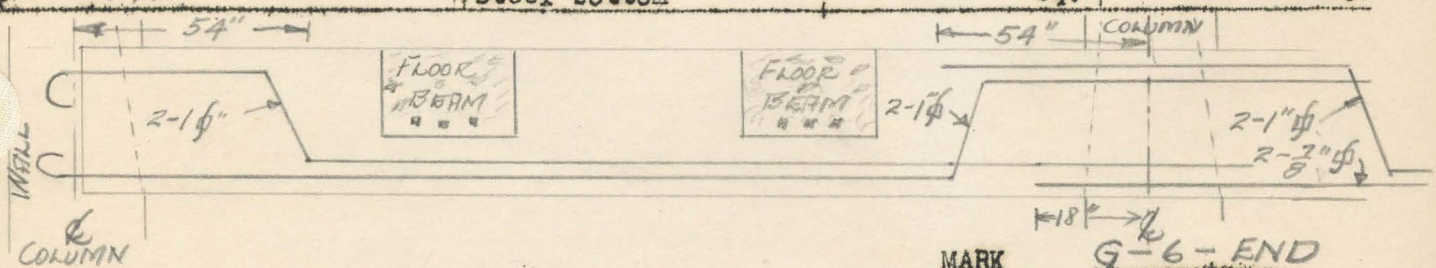
Uniform Load per Foot
Slab =
Stem 19x10x1.04 = 198

Max. Unit Shear = 100 #/"
Stirrups No = 8
1' = 72"
Spacing = 3¾-10-17¼-25½-34-43-53-65

Total Unif. Load = 3960 = 20 x 198
Conc. Loads = 30306
Total Load = 34266
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/10	1/20
M = 1,065,000 "#		M at ℄ of support	1,065,000 "#	532,500 "#
M/bd2 = M/46x(20)² = 62.1		M at face support	"#	"#
p = 46 "		M/bd²	M/10x(20)² = 266	M/10x(20)² = 133
d = 20 "		Steel top	3.8 sq."	sq."
t/d = 3/20 = .15		p	.019	
fo = 575 #/sq."		p'	.0172	
jd = .93x20 = 18.6 "		M/bd² allowable	133.5	133.5
As = .0042x46x20=3.87 sq."		f'steel	8550 #/sq."	#/sq."
Steel = 4-1ϕ" = 4.0 sq."		Length to develop	18" "	"
		Bond Stress	120 #/sq."	#/sq."
p = .0042		Steel bottom	3.44 sq."	sq."



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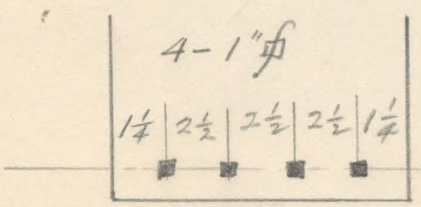

Steel at Center

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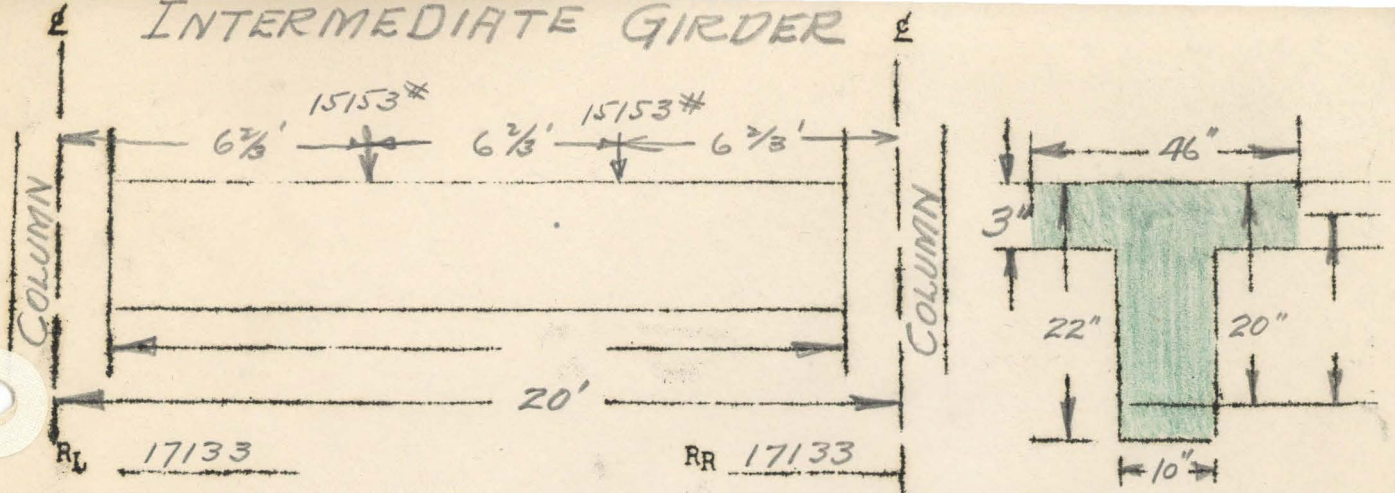
MIMEO #3

INTERMEDIATE GIRDER



R_L 17133 R_R 17133

Uniform Load per Foot
Slab =
Stem 19x10x1.04 = 198

Max. Unit Shear= 100 #/0"
Stirrups No = 8
1' = 72"
Spacing = 3½-10-17¼-25½-34-43-53-65

Total Unif.Load= 3960 = 20 x 198
Cono. Loads = 30306
Total Load = 34266
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/12	M Coef.	1/12	1/10
M = 889,300 "#	M at ℄ of support	889,300 "#	1,065,000 "#
M/bd2 = M/46x(20)² = 48.3	M at face support	"#	"#
p = 46 "	M/bd²	M/10x(20)² = 222	M/10x(20)² = 266
d = 20 "	Steel top	3.16 sq."	3.8 sq."
t/d = 3/20 = .15	p	.0158	.019
fc = 465 #/sq."	p'	.0113	.0172
jd = .933x20 = 18.66 "	M/bd² allowable	133.5	133.5
As = .0033x46x20 = 3.04 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 2-2⅜"-1-℄ = 3.53 sq."	Length to develop	18" "	18 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0033	Steel bottom	2.26 sq."	3.44 sq."

Arrangement of steel — See sketch on MIMEO #3

MARK G-6-INT

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MIMEO #4

MIMEO #5 — END SPANDREL FLOOR BEAM.

Assume — 15' between floors
12" Brick wall 120 #/sq. ft.
For the uniform load on spandrel, take a 12" wall of bricks 15' high. This will be on the safe side. This load would ordinarily consist of the bricks from the bottom of the spandrel of one floor to the top of the slab on the next + the weight of the stem.

Area req. = $\frac{13500}{105}$ = 128.5 □" Try b'=12, d=13 Area = 156 □

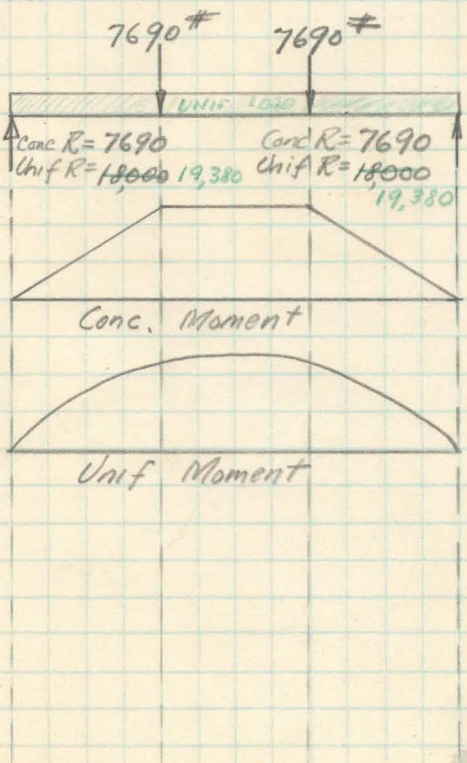
$M'_{\frac{1}{10}} = \frac{1}{10}\ 1800 \times (15)^2 \times 12 = 486\,000$ in.-lbs.
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 243,000$ in.-lbs.

MIMEO #6 — INTERMEDIATE SPANDREL F.B.

Use same dimensions as on MIMEO #5
J = .873

$v = \frac{13\,500}{.873 \times 12 \times 13} = 100\ \#/\square"$ $\quad u = \frac{13500}{.873 \times 12 \times 13} = 100\ \#/\square"$

MIMEO #7 — END SPANDREL GIRDER



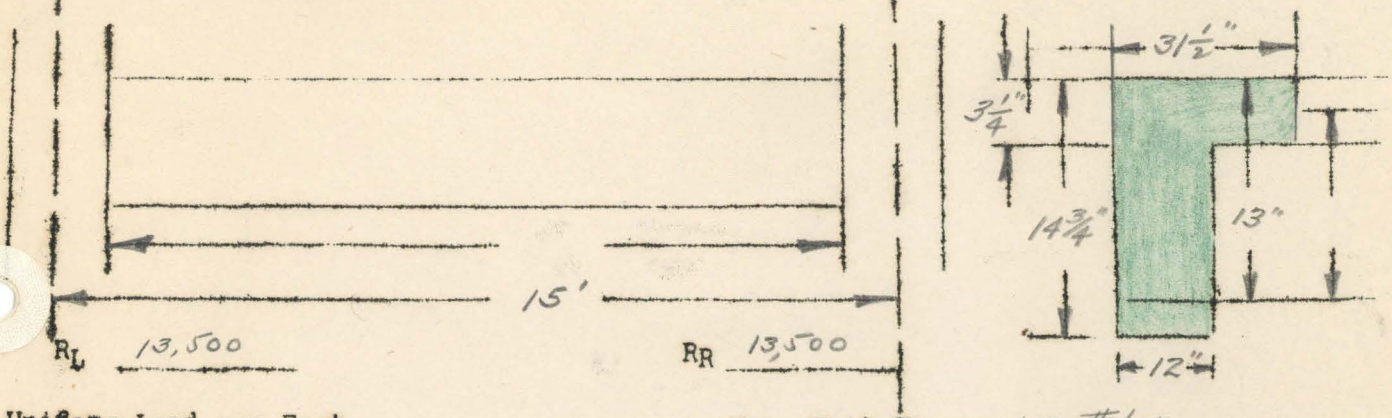
Max. Conc. Moment = 7690 x 6.67 x 12
= 615,500 in-lbs.

Conc $M_{\frac{1}{10}} = \frac{8}{10} \times 615,500 = 492,240$ "#
$M_{\frac{1}{12}} = \frac{8}{12} \times 615,500 = 410,300$ "#
$M_{\frac{1}{20}} = M_{\frac{1}{10}}/2 = 246,120$ "#

Unif $M_{\frac{1}{10}} = \frac{1}{10}$ ~~1800~~ 1938 $\times (20)^2 \times 12$
= ~~864,000~~ 930,000 in-lbs
$M_{\frac{1}{12}} =$ do $=$ ~~720,000~~ 775,000 in-lbs
$M_{\frac{1}{20}} = M_{\frac{1}{10}}/2$ = ~~432,000~~ 465,000 in-lbs

Total $M_{\frac{1}{10}} =$ ~~1,356,240~~ 1,422,240 in.-lbs.
$M_{\frac{1}{12}} =$ ~~1,130,300~~ 1,185,300 in.-lbs.
$M_{\frac{1}{20}} =$ ~~678,120~~ 711,120 in.-lbs.

℄ END SPANDREL FLOOR BEAM ℄



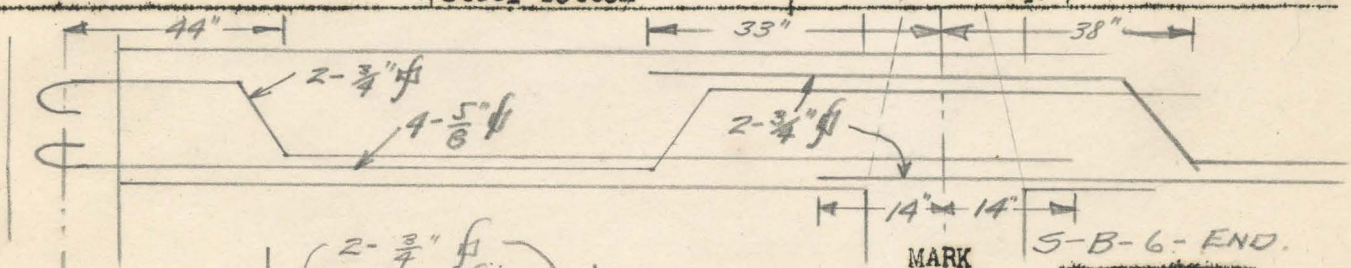
Uniform Load per Foot
Slab =
Stem =
Brick Wall - 120 x 15 = 1800

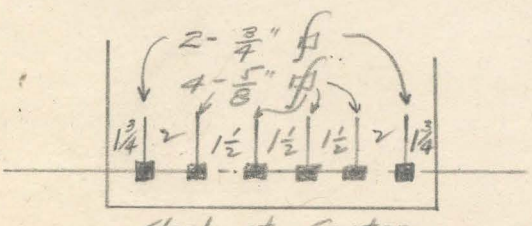
Total Unif. Load = 27,000 = 15 x 1800
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear = 100 #/10"
Stirrups No = 7
1' = 54"
Spacing = 2½ - 8¼ - 14 - 21 - 28 - 36¾ - 47

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/10	1/20
M = 486,000	"#	M at ℄ of support	486,000 "#	243,000 "#
M/bd2 = M/31.5 x (13)² = 91.5		M at face support	"#	"#
p = 31½	"	M/bd²	M/12 x (13)² = 240	M/12 x (13)² = 120
d = 13	"	Steel top	2.67 sq."	sq."
t/d = 3.25/13 = .289		p	.0171	
fo = 600	#/sq."	p'	.0139	
jd = .889 x 13 = 11.56	"	M/bd² allowable	133.5	133.5
As = .0065 x 31.5 x 13 = 2.66	sq."	f'steel	8550 #/sq."	#/sq."
Steel = 4-⅞ ϕ 2-3¼ = 2.69	sq."	Length to develop	14 "	"
		Bond Stress	120 #/sq."	#/sq."
p = .0065		Steel bottom	2.17 sq."	sq."





Steel at Center

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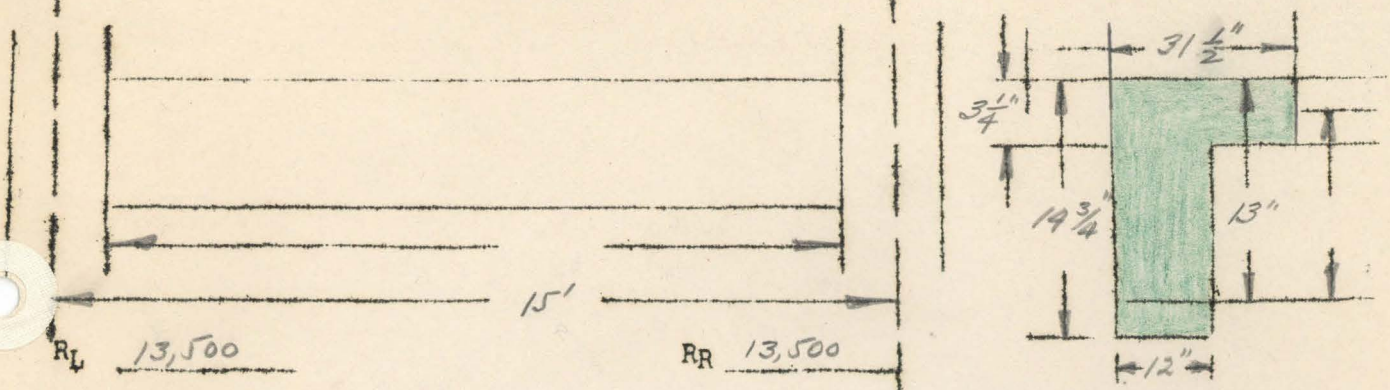
MIMEO #5

℄ INTERMEDIATE SPANDREL FLOOR BEAM ℄



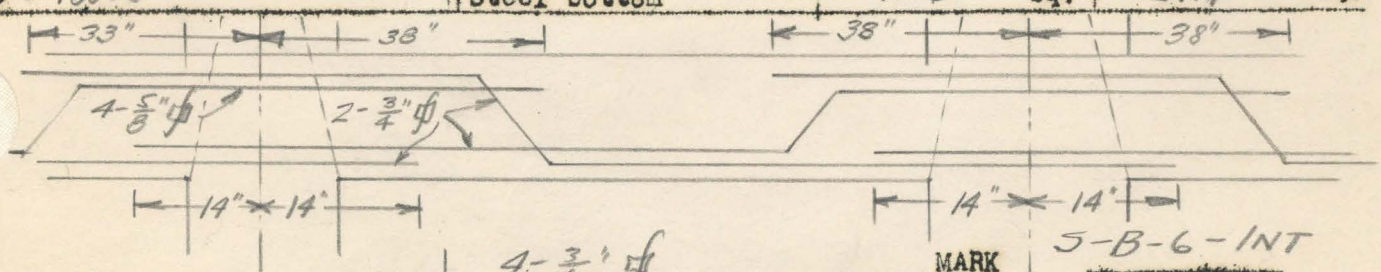
Uniform Load per Foot
Slab =
Stem =
Brick Wall -120x15 = 1800

Total Unif.Load= 27000 = 15 x 1800
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear= 100 #/□"
Stirrups No = 7
l' = 54"
Spacing = 2 1/2 - 8 1/4 - 14 - 21 - 28 - 36 3/4 - 47

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef.= 1/12		M Coef.	1/12	1/10
M = 405,000	"#	M at ℄ of support	405,000 "#	486,000 "#
M/bd2 = M/31.5"x(13)² = 76.1		M at face support	"#	"#
b = 31 1/2	"	M/bd²	M/12x(13)² = 200	M/12x(13)² = 240
d = 13	"	Steel top	2.23 sq."	2.67 sq."
t/d = 3.25/13 = .289		p	.0143	.0171
fc = 530	#/sq."	p'	.0087	.0139
jd = .895x13	"	M/bd² allowable	133.5	133.5
As = .0053x31.5x13 = 2.17	sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 4-3/4"ϕ = 2.25	sq."	Length to develop	14 "	14 "
		Bond Stress	120 #/sq."	120 #/sq."
p = .0053		Steel bottom	1.36 sq."	2.17 sq."



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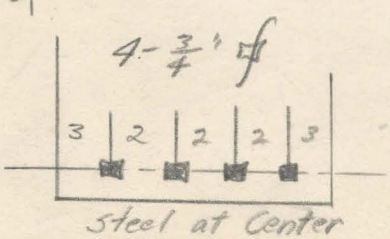

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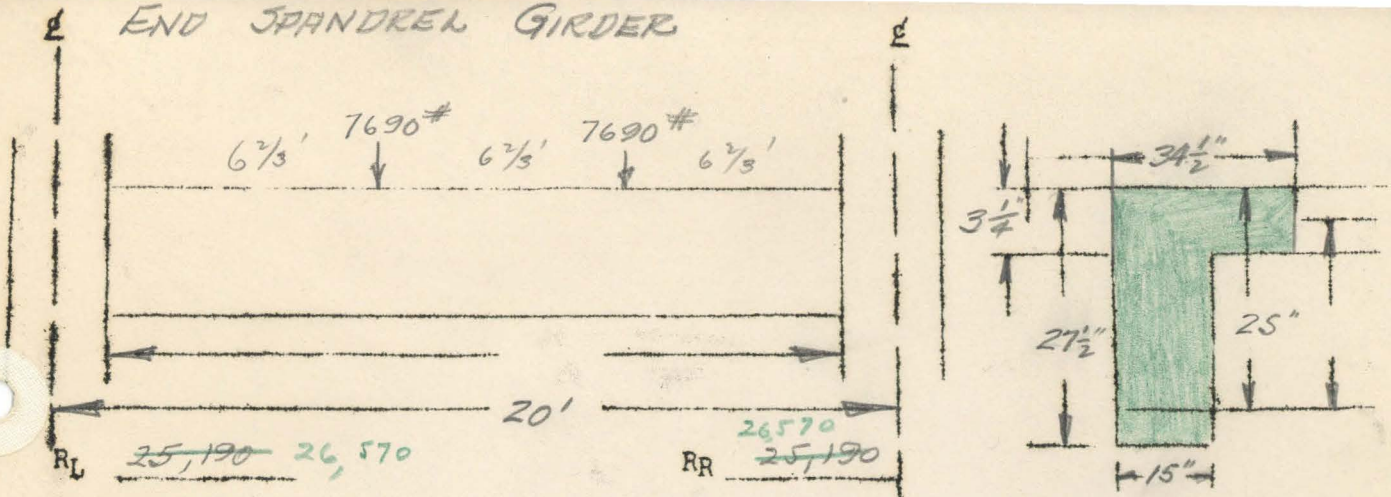
MIMEO #6

END SPANDREL GIRDER

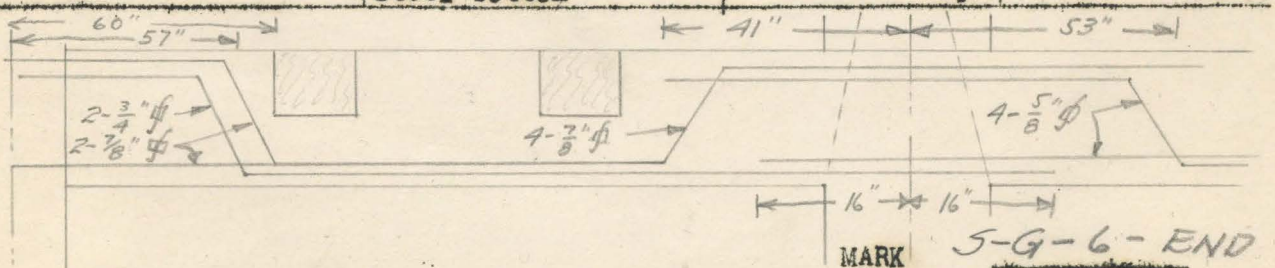


Uniform Load per Foot
Slab =
Stem 24.25x15x1.04 = 378
Brick Wall 13x120 = ~~1800~~ 1560
Total Unif.Load= ~~36000~~ 38760 = 20 x ~~1800~~ 1938
Conc. Loads = 14380
Total Load = ~~50,380~~
Equiv. Load = 53,140

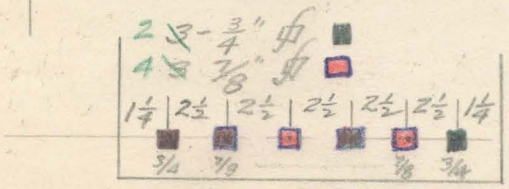
Max. Unit Shear= ~~78~~ #/0" 82 #/0"
Stirrups No = ~~7~~ 9
1' = ~~46~~" 62
Spacing = ~~2¾ - 8 - 13½ - 20 - 26½ - 34 - 41¾~~ 2½ - 7¼ - 12 - 17¾ - 23¾ - 30 - 37 - 45½ - 55½

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/10	M Coef.	1/10	1/20
M = ~~1,356,240~~ 1,422,240 "#	M at ℄ of support	~~1,356,240~~ 1,422,240 "#	~~678,120~~ 711,120 "#
M/bd2 = M/34.5x(25)²= ~~63.66~~	M at face support	"#	76 "#
b = 34½ "	M/bd²	M/15x(25)² = ~~144.7~~ 152	M/15x(25)² = ~~72.3~~
d = 25 "	Steel top	~~3.94~~ 4.19 sq."	sq."
t/d = 3.25/25 = .13	p	~~.0105~~ .011	
f_o = ~~630~~ 650 #/sq."	p'	~~.0018~~ .0024	
jd = .94x25 = 23.5 "	M/bd² allowable	133.5	133.5
As = ~~.0042~~ .0043x34.5x25= ~~3.67~~ 3.71 sq."	f'steel	8550 #/sq."	#/sq."
Steel = ~~3-¾" ℄ 2-⅞" ℄~~ = ~~3.98~~ 4.19 sq."	Length to develop	16 "	"
	Bond Stress	120 #/sq."	#/sq."
p = ~~.0042~~ .0043	Steel bottom	~~.563~~ .9 sq."	sq."



MARK 5-G-6-END



Steel at Center

Computed H.V.G. Date 4/26/24
Checked Detailed
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MIMEO #7

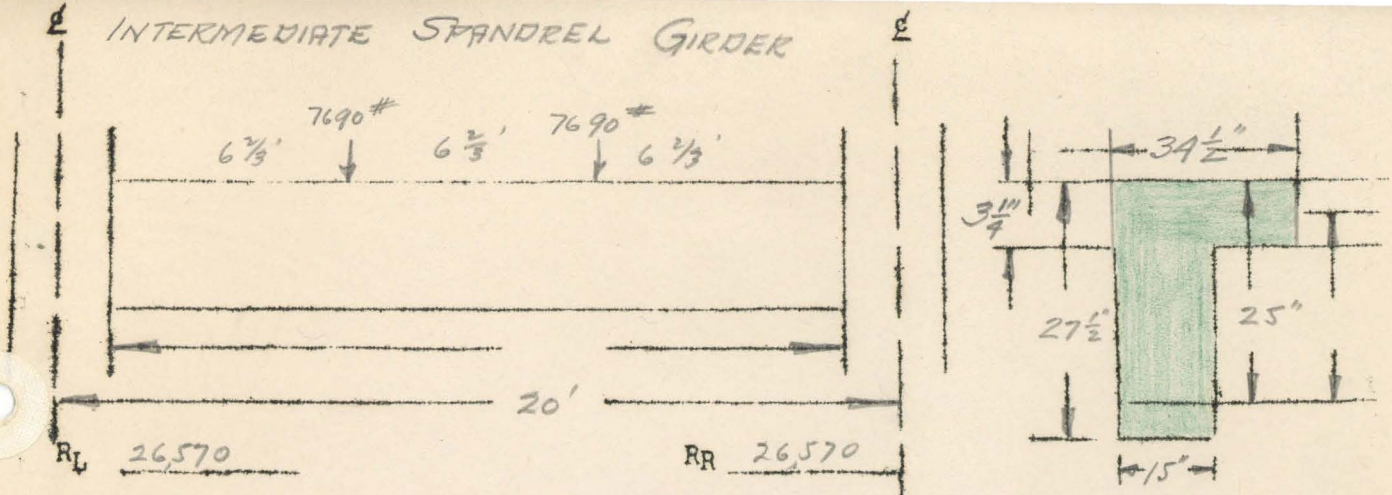
$J = .865$ $\quad V = \dfrac{\cancel{25,190}\ 26,570}{.865 \times 15 \times 25} = \cancel{77.7\ \#/10"}\ 82\ \#/10"$

$u = \dfrac{\cancel{25,190}\ 26,570}{.865 \times 25 \times 19.5} = \cancel{52.7\ \#/10"}\ 63\ \#/10"$

MIMEO #8 — INTERMEDIATE SPANDREL GIRDER

Use same dimensions as on MIMEO #7

INTERMEDIATE SPANDREL GIRDER



R_L 26570 R_R 26570

Uniform Load per Foot
Slab =
Stem 24.25 x 15 x 1.04 = 378
Wall 1560

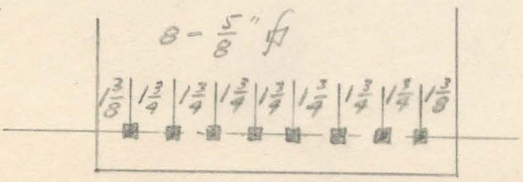
Total Unif.Load= 38760 = 20 x 1938
Conc. Loads = 14380
Total Load = 53,140
Equiv. Load =

Max. Unit Shear= 82 #/0"
Stirrups No = 9
1' = 62"
Spacing = 2½ - 7¼ - 12 - 17¾ - 23¾ - 30 - 37 - 45½ - 55½

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef.=	1/12	M Coef.	1/12	1/10
M =	1,185,300 "#	M at ℄ of support	1,185,300 "#	1,422,240 "#
M/bd2 = M/34.5 x (25)² =	55	M at face support	"#	"#
p =	34½ "	M/bd²	M/15 x (25)² = 127	M/15 x (25)² = 152
d =	25 "	Steel top	sq."	4.19 sq."
t/d =	3.75/25 = .13	p		.011
fo =	555 #/sq."	p'		.0024
jd =	.94 x 25 = 23.5 "	M/bd² allowable	133.5	133.5
As =	.0036 x 25 x 34.5 = 3.11 sq."	f'steel	#/sq."	8550 #/sq."
Steel =	8-⅝" ℓf = 3.125 sq."	Length to develop	"	16 "
		Bond Stress	#/sq."	120 #/sq."
p =	.0036	Steel bottom	sq."	.90 sq."

Bend 4-⅝" ℓf over each support at 53" from support.



Steel at Center

MARK 5-G-6 INT

Computed H.V.G.	Date 4/26/24
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MIMEO #8

EXTERIOR COLUMN ON 20' SIDE

5th to 6th

Load

Slab = 10 x 15 x 141	= 21,150
F. Beam = 1½ x 15 x 79.5	= 1,788
Spandrel + Wall = 1938 x 20	= 38,760
	61,698
Increase 20% for ecc.	12,340
Wt. of Column	4,000
	78,038 #

SQUARE COLUMN

Dia. of sq. col. = 15"
" " " core = 11"
Use 4 - 1" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 79,700 #
Wt. of column = 234 x 15 = 3510 #
∴ O.K.

4th to 5th

Load

Same as before	= 61,698
20% for ecc.	= 12,340
Load from col. above	= 78,038
Assume wt. of col.	= 7,000
	159,076 #

SQUARE COLUMN

Dia. of col = 21"
" " core = 17"
Use 6 - ⅞" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 159,000 #
Wt. of column = 459 x 15 = 6885 #
∴ O.K.

3rd to 4th

Load

Same as before	= 61,698
20% for ecc.	= 12,340
Load from col. above	= 159,076
Assume wt. of col.	= 9,500
	242,614 #

SQUARE COLUMN

Dia. of col = 24"
" " core = 20"
Use 8 - 1⅛" ⌀
" ¼" □ lateral ties spaced every 12"
Allowable load = 243,800 #
Wt. of col. = 600 x 15 = 9000 #
∴ OK.

2nd to 3rd

Load

Same as before	= 61,698
20% for ecc.	= 12,340
Load from col. above	= 242,614
Assume wt. of col.	= 7,500
	324,152 #

ROUND COLUMN

Dia. of col. = 24"
" " core = 20"
Use 14 - ⅞" ⌀
Spiral — gage = #3/0
c pitch = 2"
ρ = 1.032%
Allowable load = 324,900 #
Wt. of col. = 471 x 15 = 7065 #

Exterior Column on 20' side

1st to 2nd

Load

Same as before	= 61,698
20% for ecc.	= 12,340
Load from column above	= 324,152
Assume wt. of column	= 9,500
	407,690 #

ROUND COLUMN

Dia. of col = 27"
" " core = 23"
Use 12-1" ⌀
Spirals – gage = #4/0
pitch = 2 1/8"
p = 1.001
Allowable load = 408,500 #
Wt. of column = 15 x 596 = 8940
∴ O.K.

Exterior Column on 15' side

5th to 6th

Load

Slab = 10 x 15 x 141	= 21,150
F. Beam = 15 x 79.5	= 1,192
Spandrel and Wall = 1800 x 15	= 27,000
	49,342
Increase 20% for ecc.	9,868
Assume wt. of col	4,000
	63,210 #

SQUARE COLUMN

Dia. of col = 15"
" " core = 11"
Use 4 – 5/8" ⌀
" 1/4" □ lateral ties spaced every 12"
Allowable load = 64,300 #
Wt. of Col. = 234 x 15 = 3510 #
∴ O.K.

4th to 5th

Load

Same as before	= 49,342
Increase 20%	= 9,868
Load from col. above	= 63,210
Assume wt. of col	= 6,000
	128,420 #

SQUARE COLUMN

Dia. of col = 19"
" " core = 15"
Use 8 – 3/4" ⌀
" 1/4" □ lateral ties spaced every 12"
Allowable load = 129,600 #
Wt. of col = 377 x 15 = 5655 #
∴ O.K.

3rd to 4th

Load

Same as before	= 49,342
Increase 20%	= 9,868
Load from Col. above	= 128,420
Assume wt. of col.	= 8,000
	195,630 #

SQUARE COLUMN

Dia. of col = 22"
" " core = 18"
Use 8 – 1" ⌀
Use 1/4" □ lateral ties spaced 12"
Allowable load = 196,200 #
Wt. of col. = 504 x 15 = 7560 #
∴ O.K.

Exterior Column on 15' Side

2nd to 3rd

Load

Same as before = 49,342
20% increase = 9,868
Load from col. above = 195,630
Assume wt. of col = 10,700
265,540 #

SQUARE COLUMN

Dia. of col = 26"
" " core = 22"
Use 6 - 1 1/8" ϕ
" 1/4"□ lateral ties spaced every 12"
Allowable load = 265,600 #
Wt. of col. = 704 x 15 = 10,560 #
∴ O.K.

1st to 2nd

Load

Same as before = 49,342
Increase 20% = 9,868
Load from col. above = 265,540
Assume wt. of col = 7,750
332,500 #

ROUND COLUMN

Dia. of col. = 25"
" " core = 21"
Use 12 - 7/8" ϕ
Spiral — gage = #4/0
pitch = 2 1/4"
ρ = 1.031
Allowable load = 332,500 #
Wt. of col. = 511 x 15 = 7665 #

Interior Column

5th to 6th

Load

Slab = 20 x 15 x 138 = 41,400
F. Beam = 3 x 79.5 x 15 = 3,580
Girder = 198 x 15 = 2,970
47,950
Assume wt. of col = 4,000
51,950 #

SQUARE COLUMN

Dia. of col = 15"
" " core = 11"
Use 4 - 5/8" ϕ
" 1/4"□ lateral ties spaced every 12"
Allowable load = 64,300 #
Wt. of col = 234 x 15 = 3510 # ∴ O.K.

4th to 5th

Load

Same as before = 47,950
Load from col. above = 51,950
Assume wt. of col = 5,000
104,900 #

SQUARE COLUMN

Dia. of col = 17"
" " core = 13"
Use 6 - 7/8" ϕ
" 1/4"□ lateral ties spaced every 12"
Allowable load = 105,000 #
Wt. of col. = 302 x 15 = 4530 # ∴ OK.

Interior Column

3rd to 4th

Load

Same as before = 47,950
Load from col. above = 104,900
Assume wt. of col = 7000
159,850 #

SQUARE COLUMN

Dia. of col = 21"
" " core = 17"
Use 4 - 1⅛" ϕ
" ¼" □ lateral ties spaced every 12"
Allowable load = 161,900 #
Wt. of col. = 459 x 15 = 6885 # ∴ OK.

2nd to 3rd

Load

Same as before = 47,950
Load from col. above = 159,850
Assume wt. of col = 9500
217,300 #

SQUARE COLUMN

Dia. of col. = 24"
" " core = 20"
Use 6 - 1" ϕ
" ¼" □ lateral ties spaced every 12"
Allowable load = 217,800 #
Wt. of col = 600 x 15 = 9000 # ∴ OK

1st to 2nd

Load

Same as before = 47,950
Load from col. above = 217,300
Assume wt. of col. = 7,500
272,750 #

ROUND COLUMN

Dia. of col = 24"
" " Core = 20"
Use 14 - ⅝" ϕ
spiral — gage = #3/0
pitch = 2"
p = 1.032
Allowable load = 273,500 #
Wt. of col. = 471 x 15 = 7065 # ∴ OK.

System 1

Steel Vol.		Size	Area sq. ft.	Number	Length ft.	Volume cu. ft.	Total
	End Slab	1/4" □	.00043	240	8.3	.856	
	Int. "	1/4" □	.00043	728	9.98	3.13	
	End F. Beam	1/2" □	.001736	16	18.75	.521	
		3/4" □	.0039	16	18.75	1.17	
	Int. F. Beam	1/2" □	.001736	16	22.5	.625	
		3/4" □	.0039	16	22.5	1.405	
	End Girder	1" □	.00694	16	25.0	2.776	
	Int. Girder	7/8" □	.00532	4	30.0	.6384	
		1" □	.00694	4	30.0	1.6656	
	End Span. F.B.	5/8" □	.00271	8	18.75	.407	
		3/4" □	.0039	4	18.75	.293	
	Int. Span. F.B.	3/4" □	.0039	8	22.5	.702	
	End Span. Gir.	3/4" □	.0039	4	25.0	.39	
		7/8" □	.00532	8	25.0	1.064	
	Int. Span. Gir.	5/8" □	.00271	8	30.0	.651	
							16.294
	End Ext. Col						
	5th to 6th	1" □	.00694	8	17	.944	
		1/4" □	.00043	30	3.67	.0474	
	4th to 5th	7/8" □	.00532	12	17	1.088	
		1/4" □	.00043	30	5.67	.0731	
	3rd to 4th	1 1/8" □	.00879	16	17	2.39	
		1/4" □	.00043	30	6.67	.086	
	2nd to 3rd	7/8" □	.00532	28	17	2.535	
		Spiral	[.01032 x 2.18 x 15] x 2 =			.675	
	1st to 2nd	1" □	.00694	24	17	2.83	
		Spiral	[.01001 x 2.89 x 15] x 2 =			.868	
	Side Ext. Col.						
	5th to 6th	5/8" □	.00271	24	17	1.106	
		1/4" □	.00043	90	3.67	.1457	
	4th to 5th	3/4" □	.0039	48	17	3.18	
		1/4" □	.00043	90	5	.1936	
	3rd to 4th	1" □	.00694	48	17	5.66	
		1/4" □	.00043	90	6	.2325	
	2nd to 3rd	1 1/8" □	.00879	36	17	5.38	
		1/4" □	.00043	90	7.33	.284	
	1st to 2nd	7/8" □	.00532	72	17	6.51	
		Spiral	[.01031 x 2.41 x 15] x 6 =			2.24	

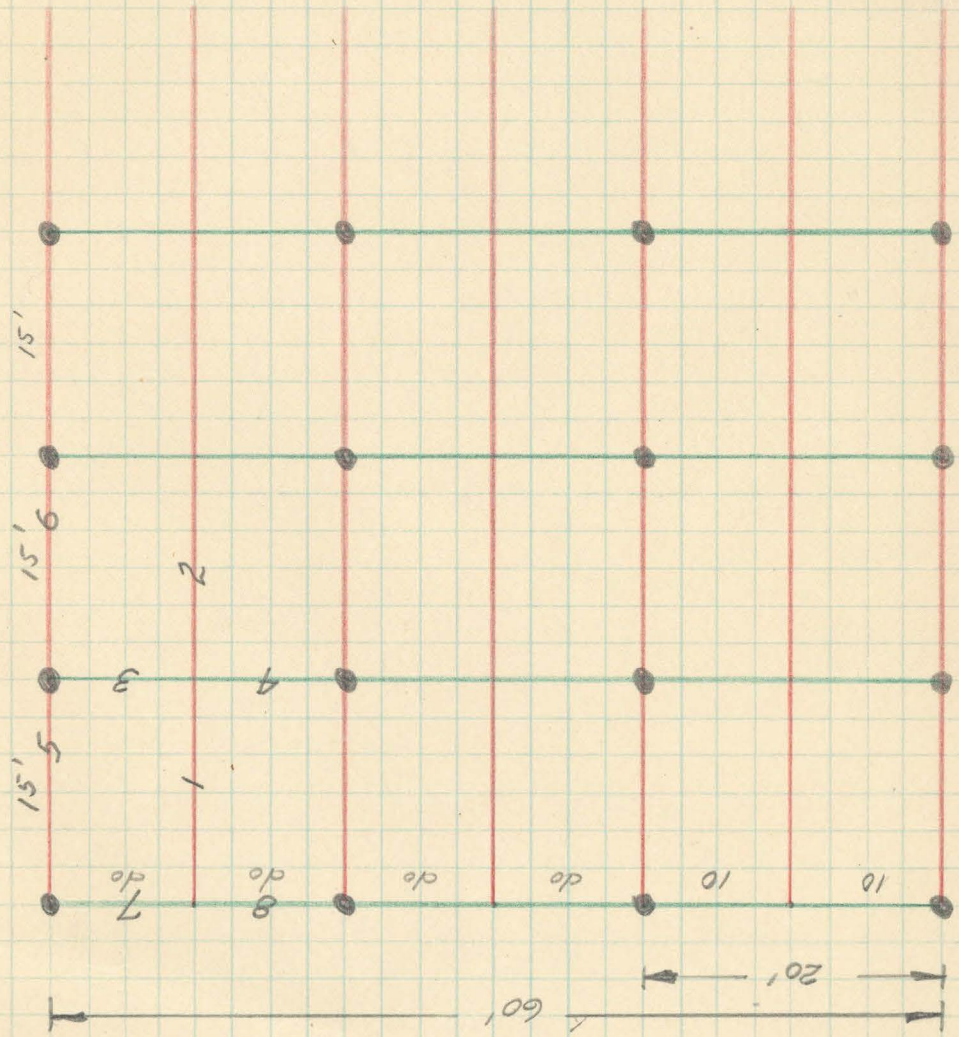
System 1

		SIZE	AREA Sq. ft.	NUMBER	LENGTH ft	VOLUME CU. ft.	TOTAL
Steel Vol	Interior Col.						
	5th to 6th	5/8" □	.00271	16	17	.737	
		1/4" □	.00043	60	3.67	.0946	
	4th to 5th	7/8" □	.00532	24	17	2.17	
		1/4" □	.00043	60	4.33	.1117	
	3rd to 4th	1 1/8" □	.00879	16	17	2.39	
		1/4" □	.00043	60	5.67	.1463	
	2nd to 3rd	1" □	.00694	24	17	2.83	
		1/4" □	.00043	60	6.67	.1721	
	1st to 2nd	5/8" □	.00271	56	17	2.585	
		Spiral	[.01032 x 2.18 x 15] x 4		=	1.35	
							49.055

		CROSS-SEC. AREA Sq. inches	X-sec. A. Sq-ft.	NUM.	LENGTH ft.	VOLUME CU. FT.	TOTAL
Concrete Vol.	End Slab	3.25 x 360 = 1170	8.13	2	6.67	108.5	
	Int. Slab	3 x 360 = 1080	7.5	7	6.67	350.0	
	End F. Beam	10 x 8 = 80	.556	8	15	66.8	
	Int. F. Beam	10.25 x 7 = 71.8	.499	8	15	59.9	
	End Girder	19 x 10 = 190	1.32	4	20	105.6	
	Int. Girder	19 x 10 = 190	1.32	2	20	52.8	
	End Span. F.B.	11.5 x 12 = 138	.959	2	15	28.77	
	Int. Span. F.B.	11.5 x 12 = 138	.959	2	15	28.77	
	End Span. Gir.	24.25 x 15 = 363.7	2.523	2	20	100.92	
	Int. Span. Gir.	24.25 x 15 = 363.7	2.523	1	20	50.46	952.52
		SIZE	Vol. C.f/Ft.	NUM	LEN.	VOLUME	TOTAL
	End. Ext. Col.	col. Core					
	5th to 6th	15" x 11" □	1.56	2	15	46.8	
	4th to 5th	21" x 17" □	3.06	2	15	91.8	
	3rd to 4th	24" x 20" □	4.00	2	15	120.0	
	2nd to 3rd	24" x 20" ○	3.14	2	15	94.2	
	1st to 2nd	27" x 23" ○	3.98	2	15	119.4	
	Side Ext. Col.						
	5th to 6th	15" x 11" □	1.56	6	15	140.4	
	4th to 5th	19" x 15" □	2.51	6	15	225.9	
	3rd to 4th	22" x 18" □	3.36	6	15	302.4	
	2nd to 3rd	26" x 22" □	4.69	6	15	422.1	
	1st to 2nd	25" x 21" ○	3.41	6	15	306.9	
	Int. Col.						
	5th to 6th	15" x 11" □	1.56	4	15	93.6	
	4th to 5th	17" x 13" □	2.01	4	15	120.6	
	3rd to 4th	21" x 17" □	3.06	4	15	183.6	
	2nd to 3rd	24" x 20" □	4.00	4	15	240.0	
	1st to 2nd	24" x 20" ○	3.14	4	15	188.4	
							2,696.10

SYSTEM NO.2

SYSTEM No. 2



End Slab

Moment at Center —
$\frac{1}{10} \times 160 \times (10)^2 \times 12 = 19200$ in-lbs

Live load = 100
Dead " = 60
Total 160 #/□'

$$d^2 = \frac{19200}{.0077 \times 16000 \times .874 \times 12} = 14.84 \text{ □"}$$

$d = 3.855$ say 4"
Take $\frac{3}{4}$" below steel

Area of steel / ft. of breadth = $.0077 \times 12 \times 4 = .37$ □"
Use $\frac{3}{8}$" ϕ spaced every $4\frac{1}{2}$" c. on c.

Check on dead load — $4.75 \times 12 \times 1.04 = 59.3$ #/□' ∴ OK Total = 160 #/□'

Shear at end / ft. of breadth = $5 \times 160 = 800$ #
Allowable shear = $40 \times 12 \times 4 = 1920$ #
∴ No web reinforcement needed.

MIMEO #1

6-1

Moment $\frac{1}{10}$ = $\frac{1}{10}$ $1707 \times (15)^2 \times 12 = 460,500$ "#
" $\frac{1}{20}$ = $\frac{1}{20}$ do = 230,250 "#

INT. SLAB.

Moment at Center —
$\frac{1}{12} \times 160 \times (10)^2 \times 12 = 16,000$ "#

Live load = 100
Dead " = 60
Total 160 #/□'

$$d^2 = \frac{16000}{.0077 \times 16000 \times .874 \times 12} = 12.4 \text{ □"}$$

$d = 3.52$ say $3\frac{1}{2}$"
Take $\frac{3}{4}$" below steel

Area of steel / ft. of breadth = $.0077 \times 12 \times 3.5 = .3235$ □"
Use $\frac{3}{8}$" ϕ spaced every $5\frac{1}{4}$" c. on c.

Check on dead load = $4.25 \times 12 \times 1.04 = 53$ # ∴ OK. Total = 153 #/□

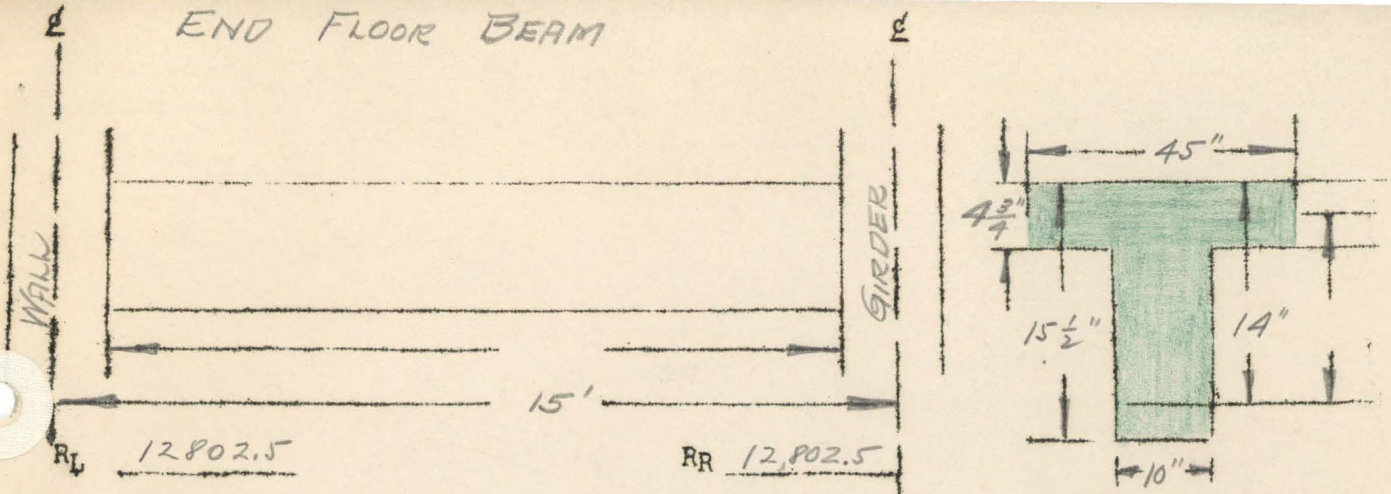
Shear at end / ft. of breadth = $5 \times 153 = 765$ #
Allowable shear = $40 \times 12 \times 3.5 = 1680$ #
∴ No web reinforcement.

MIMEO #2

6-2

Moment $\frac{1}{10}$ = $\frac{1}{10}$ $1627 \times (15)^2 \times 12 = 439,500$ "#
" $\frac{1}{12}$ = $\frac{1}{12}$ $1627 \times (15)^2 \times 12 = 366,000$ "#

END FLOOR BEAM



Uniform Load per Foot

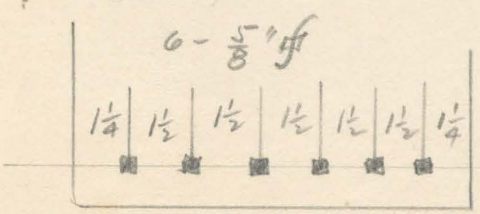
Slab 10 x 160	=	1600
Stem 10.25 x 10 x 1.04	=	107

Max. Unit Shear = 105 #/□"
Stirrups No = 6
l' = 56"
Spacing = 3-10-$17\frac{3}{4}$-26-36-48

Total Unif. Load = 25605 = 15 x 1707
Conc. Loads =
Total Load =
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = $\frac{1}{10}$	M Coef.	$\frac{1}{10}$	$\frac{1}{20}$
M = 460,500 "#	M at ℄ of support	460,500 "#	230,250 "#
$M/bd^2 = M/45 \times (14)^2 = 52.3$	M at face support	"#	"#
b = 45 "	M/bd^2	$M/10 \times (14)^2 = 235$	$M/10 \times (14)^2 = 118$
d = 14 "	Steel top	2.35 sq."	sq."
t/d = 4.75/14 = .339	p	.0168	
fo = 410 #/sq."	p'	.0132	
jd = .905 x 14 = 12.69 "	M/bd^2 allowable	133.5	133.5
As = .00362 x 45 x 14 = 2.28 sq."	f' steel	8550 #/sq."	#/sq."
Steel = 6-$\frac{5}{8}$"ff = 2.344 sq."	Length to develop	12 "	"
	Bond Stress	120 #/sq."	120 #/sq."
p = .00362	Steel bottom	1.85 sq."	sq."



Steel at Center

MARK 6-1

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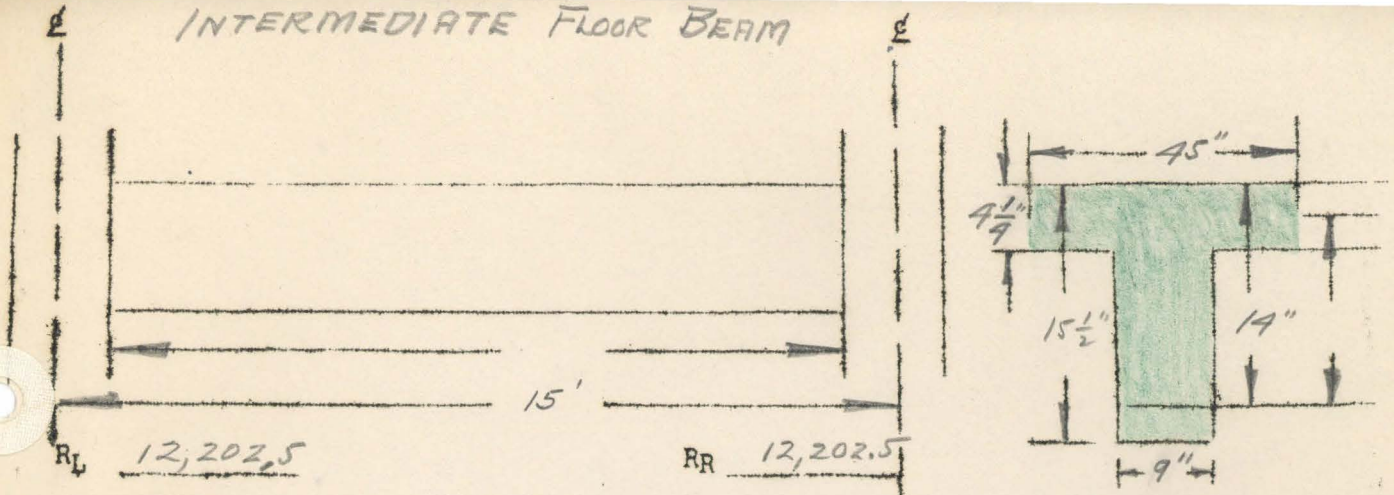
MIMEO #1

INTERMEDIATE FLOOR BEAM



R_L 12,202.5 R_R 12,202.5

Uniform Load per Foot
Slab 10x153 = 1530
Stem 10.25x9x1.04 = 97
Total Unif.Load = 24,405 = 15 x 1627
Conc. Loads =
Total Load =
Equiv. Load =

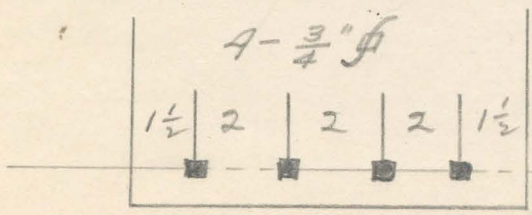
Max. Unit Shear = 114 #/□"
Stirrups No = 6
l' = 58"
Spacing = 3 1/4 - 10 1/2 - 18 1/2 - 27 - 37 1/2 - 50

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/12		M Coef.	1/12	1/10
M = 366,000	"#	M at ℄ of support	366,000 "#	439,500 "#
M/bd2 = M/45x(14)² = 41.5		M at face support	"#	"#
b = 45	"	M/bd²	M/9x(14)² = 207.5	M/9x(14)² = 249
d = 14	"	Steel top	1.879 sq."	2.24 sq."
t/d = 4.25/14 = .3035		p	.0149	.0178
fc = 360	#/sq."	p'	.0096	.015
jd = .915x14 = 12.8	"	M/bd² allowable	133.5	133.5
As = .00285x45x14 = 1.8	sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 4-3/4"ϕ = 2.25	sq."	Length to develop	14" "	14 "
		Bond Stress	120 #/sq."	120 #/sq."
p = .00285		Steel bottom	1.21 sq."	1.89 sq."

Steel at left
Top - 4-5/8"ϕ
Bot 2-3/4"ϕ

Steel at right
Top - 4-3/4"ϕ
Bot - 4-3/4"ϕ



Steel at Center

MARK 6-2

Computed H.V.G. Date 5/11/24
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MIMEO #2

MIMEO #3 6-3 END GIRDER

Concentrated Moment = 12,502.5 x 10 x 12 = 1,501,000 "#

$M_{\frac{1}{10}}$ = 1,501,000 x $\frac{8}{10}$ = 1,201,000 "#

$M_{\frac{1}{20}}$ = do $\frac{8}{20}$ = 600,500 "#

Unif. Moment — Wt. of stem = 240 #/ft.

$M_{\frac{1}{10}}$ = $\frac{1}{10}$ 240 x (20)^2 x 12 = 115,200 "#

$M_{\frac{1}{20}}$ = $\frac{1}{20}$ do = 57,600 "#

Total Moment —

$M_{\frac{1}{10}}$ = 1,316,200 "#

$M_{\frac{1}{20}}$ = 658,100 "#

MIMEO #4 6-4

Use same dimensions as before

Conc $M_{\frac{1}{12}}$ = 1,501,000 x $\frac{8}{12}$ = 1,000,700 "#

Unif $M_{\frac{1}{12}}$ = 96,000 "#

Total $M_{\frac{1}{12}}$ = 1,096,700 "#

MIMEO #5 6-5

MIMEO #6 6-6

MIMEO #7 6-7

Concentrated Moment = 6401.3 x 10 x 12 = 768,156 "#

$M_{\frac{1}{10}}$ = 768,156 x $\frac{8}{10}$ = 614,500 "#

$M_{\frac{1}{20}}$ = 768,156 x $\frac{8}{20}$ = 307,250 "#

Unif. Moment — Wt. of stem = 250 #/ft Wall = 1560

$M_{\frac{1}{10}}$ = $\frac{1}{10}$ x 1810 x (20)^2 x 12 = 869,500 "#

$M_{\frac{1}{20}}$ = $\frac{1}{20}$ do = 434,750 "#

Total Moment —

$M_{\frac{1}{10}}$ = 1,484,000 "#

$M_{\frac{1}{20}}$ = 742,000 "#

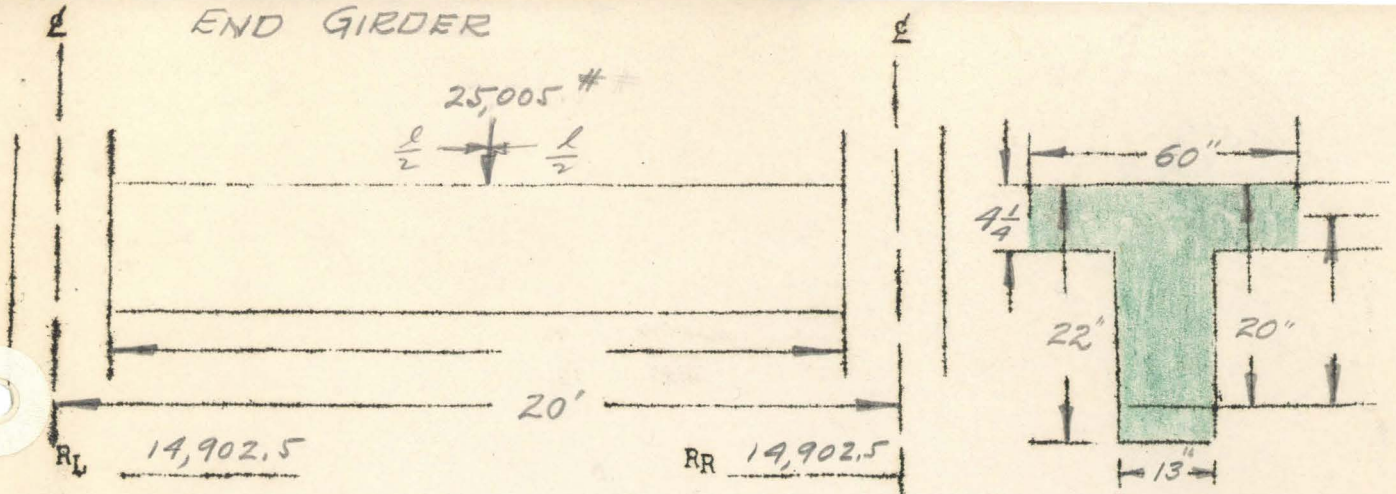
MIMEO #8 6-8

Conc. Moment $\frac{1}{12}$ = 768,156 x $\frac{8}{12}$ = 512,000 "#

Unif Moment $\frac{1}{12}$ = $\frac{1}{12}$ x 1810 x (20)^2 x 12 = 724,000 "#

Total $M_{\frac{1}{12}}$ = 1,236,000 "#

END GIRDER



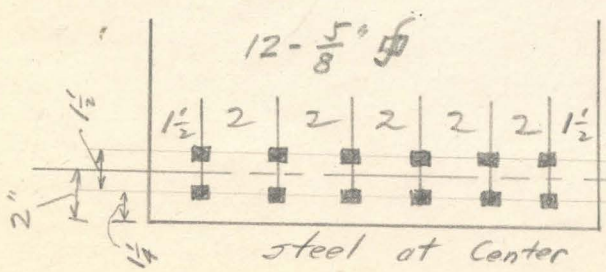
Uniform Load per Foot
Slab =
Stem 17.75 x 13 x 1.04 = 240

Max. Unit Shear = 65 #/10"
Stirrups No = 5
l' = 46"
Spacing = 3¼ - 11½ - 20¼ - 30 - 40½

Total Unif. Load = 4800 = 20 x 240
Conc. Loads = 25005
Total Load = 29805
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = 1/10	M Coef.	1/10	1/20
M = 1,316,200 "#	M at ℄ of support	1,316,200 "#	658,100 "#
M/bd2 = M/60 x (20)² = 55	M at face support	"#	"#
p = 60 "	M/bd²	M/13 x (20)² = 253.5	M/13 x (20)² = 126.8
d = 20 "	Steel top	4.705 sq."	sq."
t/d = 4.25/20 = .212	p	.0181	
fc = 445 #/sq."	p'	.0156	
jd = .915 x 20 = 18.3 "	M/bd² allowable	133.5	133.5
As = .0038 x 60 x 20 = 4.56 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 12 - 5/8" ℄ = 4.687 sq."	Length to develop	12" "	"
	Bond Stress	120 #/sq."	120 #/sq."
p = .0038	Steel bottom	4.06 sq."	sq."



MARK 6 - 3

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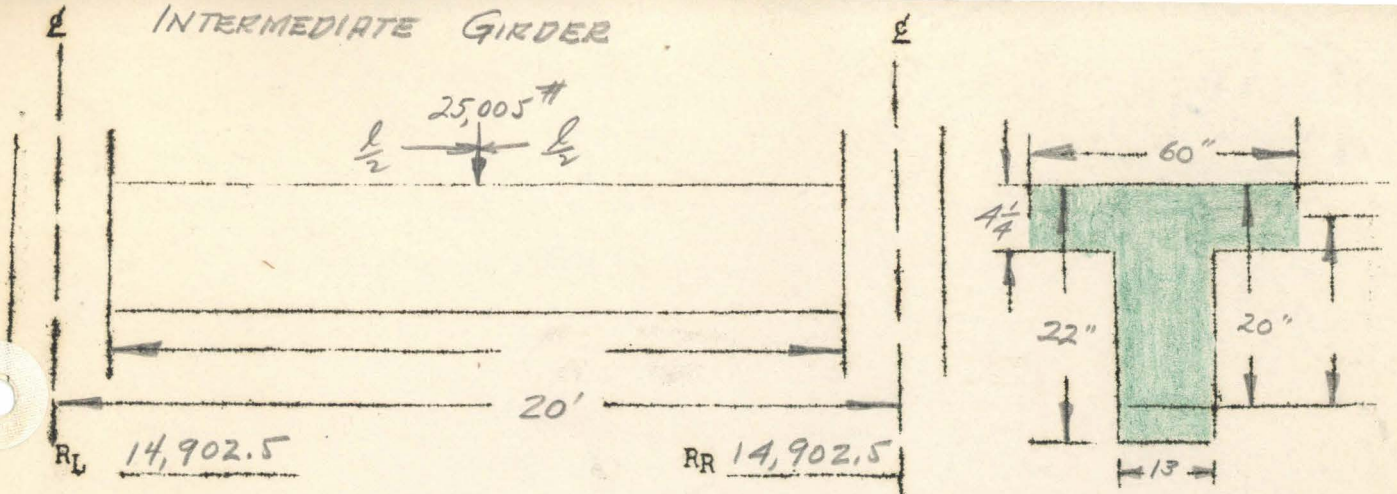
MIMEO # 9

INTERMEDIATE GIRDER



Uniform Load per Foot
Slab =
Stem 17.75 x 13 x 1.04 = 240.

Max. Unit Shear = 65 #/□"
Stirrups No = 5
l' = 46"
Spacing = 3 1/4 - 11 1/2 - 20 1/4 - 30 - 40 1/2

Total Unif. Load = 4800 = 20 x 240
Conc. Loads = 25005
Total Load = 29,805
Equiv. Load =

d'/d = 1/10

CENTER	SUPPORT	Right	Left
M Coef. = 1/12	M Coef.	1/12	1/10
M = 1,096,700 "#	M at ℄ of support	1,096,700 "#	1,316,200 "#
M/bd2 = M/60 x (20)² = 45.7	M at face support	"#	"#
b = 60 "	M/bd²	M/13 x (20)² = 211	M/13 x (20)² = 253.5
d = 20 "	Steel top	3.925 sq."	4.705 sq."
t/d = 4.25/20 = .212	p	.0151	.0181
fo = 390 #/sq."	p'	.0101	.0156
jd = .918 x 20 = 18.36 "	M/bd² allowable	133.5	133.5
As = .0031 x 60 x 20 = 3.72 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 12 - 5/8" ℄ = 4.687 sq."	Length to develop	12 "	12 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0031	Steel bottom	2.625 sq."	4.06 sq."

Spacing of steel same as for END GIRDER

MARK 6-4

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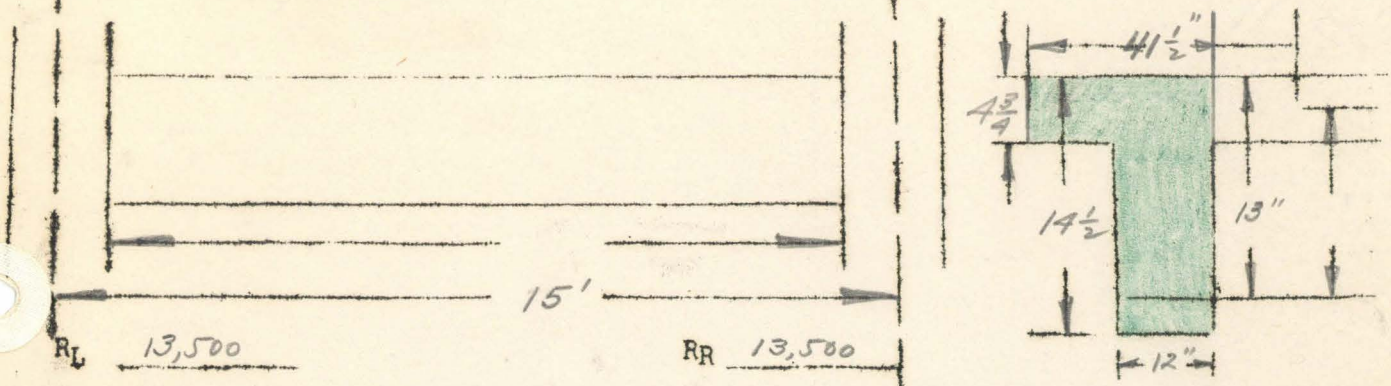
MIMEO #4

℄ END SPANDREL FLOOR BEAM ℄



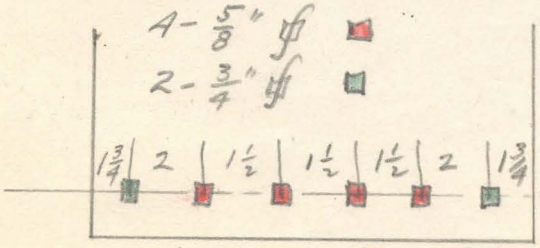
Uniform Load per Foot
Slab =
Stem =
Brick Wall - 120 x 15 = 1800

Total Unif.Load= 27,000 = 15 x 1800
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear= 100 #/0"
Stirrups No = 7
l' = 54"
Spacing = 2½ - 8¼ - 14 - 21 - 28 - 36¾ - 47

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/10	M Coef.	1/10	1/20
M = 486,000 "#	M at ℄ of support	486,000 "#	243,000 "#
M/bd2 = M/(41½)(13)² = 69.4	M at face support	"#	"#
b = 41½ "	M/bd²	M/12x(13)² = 240	M/12x(13)² = 120
d = 13 "	Steel top	2.67 sq."	sq."
t/d = 4.75/13 = .365	p	.0171	
fo = 490 #/sq."	p'	.0139	
jd = .895x13 = 11.63 "	M/bd² allowable	133.5	133.5
As = .00485 x 40.5 x 13 = 2.56 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 4-⅝" sq + 2-¾" sq = 2.69 sq."	Length to develop	14 "	"
	Bond Stress	120 #/sq."	#/sq."
p = .00485	Steel bottom	2.17 sq."	sq."



Steel at Center

MARK 6-5

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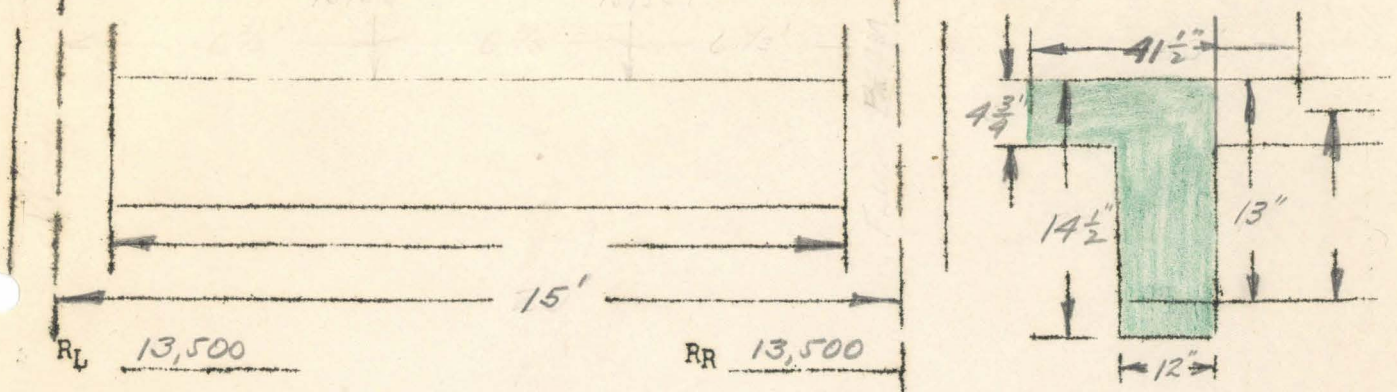
MIMEO #5

℄ INTERMEDIATE SPANDREL FLOOR BEAM ℄



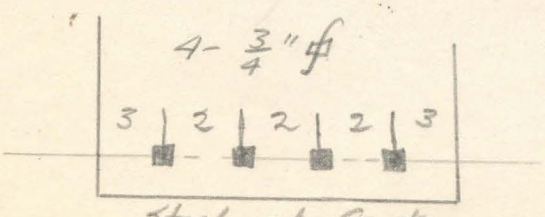
Uniform Load per Foot
Slab =
Stem =
Brick Wall - 120x15 = 1800

Total Unif.Load= 27,000 = 15 x 1800
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear= 100 #/10"
Stirrups No = 7
l' = 54"
Spacing = 2½ - 8¼ - 14 - 21 - 28 - 36¾ - 47

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/12	M Coef.	1/12	1/10
M = 405,000 "#	M at ℄ of support	405,000 "#	486,000 "#
M/bd2 = M/(41.5)(13)² = 57.8	M at face support	"#	"#
b = 41½ "	M/bd²	M/12x(13)² = 200	M/12x(13)² = 240
d = 13 "	Steel top	2.23 sq."	2.67 sq."
t/d = 4.75/13 = .365	p	.0143	.0171
fc = 430 #/sq."	p'	.0087	.0139
jd = .901x13 = 11.7 "	M/bd² allowable	133.5	133.5
As = .004x41.5x13 = 2.16 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 4-¾"ϕ = 2.25 sq."	Length to develop	14 "	14 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .004	Steel bottom	1.36 sq."	2.17 sq."



Steel at Center

MARK 6-6

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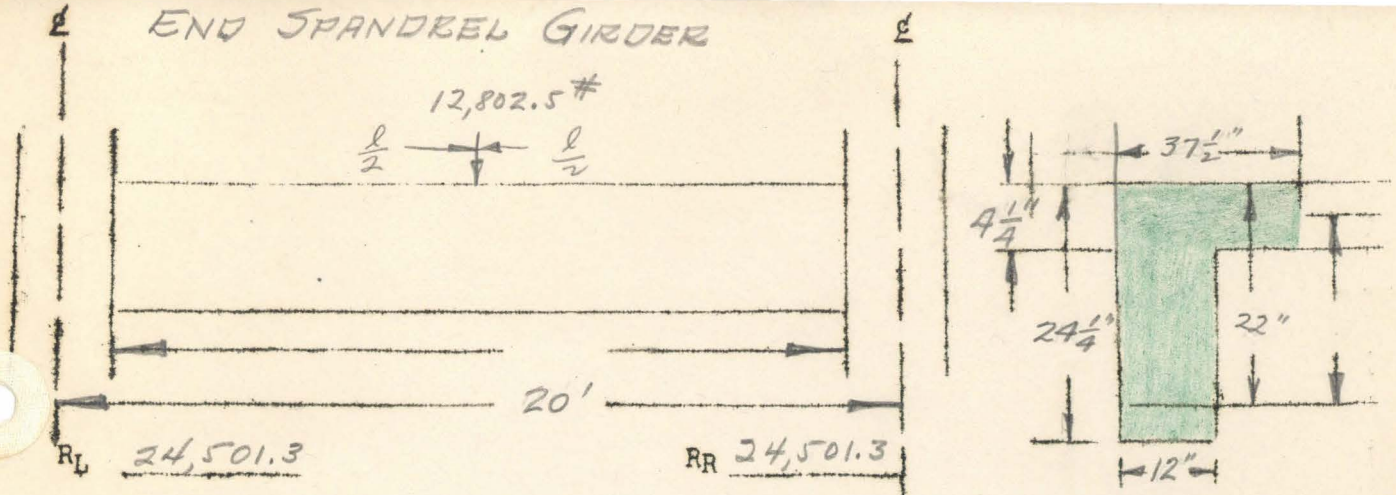
MIMEO #6

END SPANDREL GIRDER



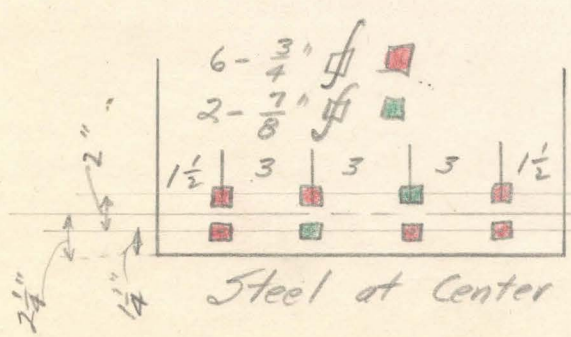
Uniform Load per Foot
Slab =
Stem 20x12x1.04 = 250
Brick Wall - 13x120 = 1560

Total Unif.Load= 36200 = 20 x 1810
Conc. Loads = 12802.5
Total Load = 49,002.5
Equiv. Load =

Max. Unit Shear= 107 #/a"
Stirrups No = 10
1' = 75"
Spacing = 2-5-11-17-23¾-31-39-47½-57¾-70

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef.= 1/10		M Coef.	1/10	1/20
M = 1,484,000	"#	M at ℄ of support	1,484,000 "#	742,000 "#
M/bd2 = M/(37½)(22)² = 81.9		M at face support	"#	"#
b = 37½	"	M/bd²	M/12x(22)²=256	M/12x(22)²=128
d = 22	"	Steel top	4.83 sq."	sq."
t/d = 4.25/22 = .193		p	.0183	
fo = 630	#/sq."	p'	.016	
jd = .916x22 = 20.17	"	M/bd² allowable	133.5	133.5
As = .0056x37.5x22 = 4.62	sq."	f'steel	8550 #/sq."	#/sq."
Steel = 6-¾" sq + 2-⅞" sq = 4.91	sq."	Length to develop	16" "	"
		Bond Stress	120 #/sq."	#/sq."
p = .0056		Steel bottom	4.22 sq."	sq."



Steel at Center

MARK 6-7

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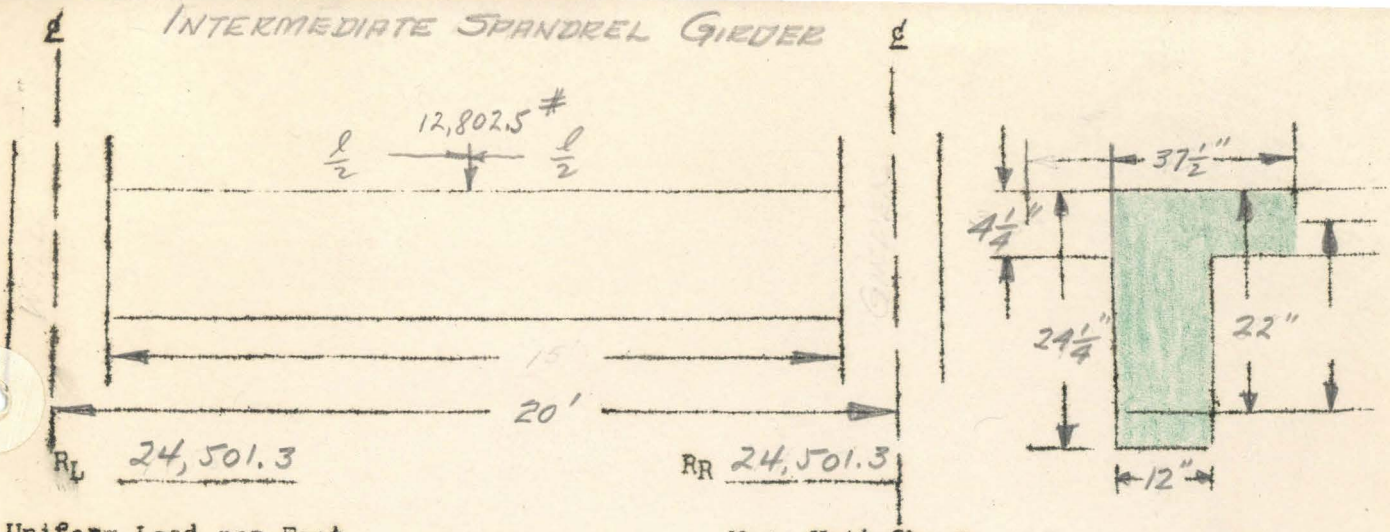
MIMEO #7

INTERMEDIATE SPANDREL GIRDER



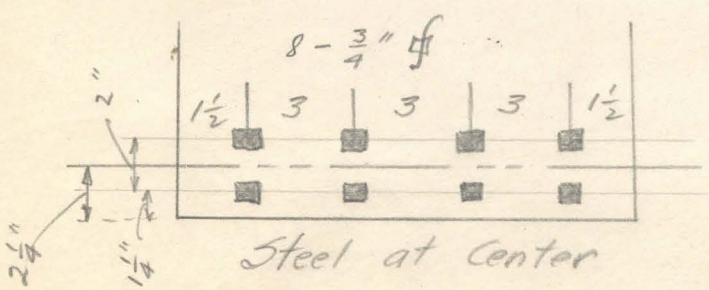
Uniform Load per Foot
Slab =
Stem 20 x 12 x 1.04 = 250
Brick Wall -13x120 = 1560

Max. Unit Shear=
Stirrups No =
1' =
Spacing =

Total Unif.Load= 36 200 = 20 x 1,810
Conc. Loads = 12 802.5
Total Load = 49,002.5
Equiv. Load =

CENTER		SUPPORT	Right	Left
M Coef.= 1/12		M Coef.	1/12	1/10
M = 1,236,000	"#	M at ℄ of support	1,236,000 "#	1,484,000 "#
M/bd2 = M/(37.5)(22)² = 68.1		M at face support	"#	"#
b = 37½	"	M/bd²	M/12x(22)² = 213	M/12x(22)² = 256
d = 22	"	Steel top	4.02 sq."	4.83 sq."
t/d = 4.25/22 = .193		p	.0152	.0183
fo = 545	#/sq."	p'	.0102	.016
jd = .917x22 = 20.18	"	M/bd² allowable	133.5	133.5
As = .0047x37.5x22=3.88	sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 8-¾"ϕ = 4.5	sq."	Length to develop	14 "	14 "
		Bond Stress	120 #/sq."	120 #/sq."
p = .0047		Steel bottom	2.69 sq."	4.22 sq."

Steel at left support
Top - {2 - ⅞"ϕ
{6 - ¾"ϕ
Bot - 8 - ¾"ϕ



Steel at Center

MARK 6-8

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MIMEO #8

Exterior Column on 20' Side

5th to 6th

Load

Slab - 10x15x153 = 22,950
F.Beam - 15x1707 = 25,606
Spandrel - 1810x20 = 36,200
84,756 #
Increase 20% 16,951
Wt. of col 5,000
106,707 #

SQUARE COLUMN

Dia of column = 17"
" " core = 13"
Use 4 - 1⅛" ⌀
" ¼" □ lateral ties spaced every 12"
Allowable load = 107,900 #
Wt. of column = 302x15 = 4530 # ∴OK

4th to 5th

Load

Same as before = 84,756
Increase 20% = 16,951
Load from col. above = 106,707
Assume wt. of col. = 9500
217,914 #

SQUARE COLUMN

Dia. of col = 24"
" " core = 20"
Use 6 - 1" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 217,800 #
Wt. of col = 600x15 = 9000 # ∴OK.

3rd to 4th

Load

Same as before = 84,756
Increase 20% = 16,951
Load from col. above = 217,914
Assume wt. of col. = 8,000
327,621 #

ROUND COLUMN

Dia. of col = 25"
" " core = 21"
Use 16 - ¾" ⌀
Spiral - gage = #4/0
pitch = 2¼"
ρ = 1.031
Allowable load = 330,700 #
Wt. of col = 511x15 = 7665 # ∴OK.

2nd to 3rd

Load

Same as before = 84,756
Increase 20% = 16,951
Load from col. above = 327,621
Assume wt. of col. = 9,500
438,828 #

ROUND COLUMN

Dia. of col. = 27"
" " core = 23"
Use 12 - 1⅛" ⌀
Spiral - gage = #4/0
pitch = 2⅛"
ρ = 1.0005
Allowable load = 439,700 #
Wt. of col. = 596x15 = 8940 # ∴O.K.

1st to 2nd

Load

Same as before = 84,756
Increase 20% = 16,951
Load from col. above = 438,828
Assume wt. of col. = 12,000
552,535 #

ROUND COLUMN

Dia. of col = 31"
" " core = 27"
Use 16 - 1" ⌀
Spiral :- gage = #5/0, pitch = 2⅛", ρ = 1.018
Allowable load = 557,600 #
Ch. on wt. of col. = 786x15 = 11,790 # ∴OK

Exterior Column on 15' side

5th to 6th

Load

Slab – 10×15×150	=	22,500
F. Beam – 166.7 × 7.5	=	12,503
Girder – 240×10	=	2,400
Spandrel – 1800×15	=	27,000
		64,403 #
Increase 20%		12,881
Assume wt. of col.		4,000
		81,284 #

Square Column

Dia. of col. = 15"
" " core = 11"
Use 8 – 3/4" ⌀
" 1/4" □ lateral ties spaced every 12"
Allowable load = 82,800 #
Wt. of col. = 234×15 = 3510 # ∴ O.K.

4th to 5th

Load

Same as before	=	64,403
Increase 20%	=	12,881
Load from col. above	=	81,284
Assume wt. of col.	=	6,500
		165,068 #

Square Column

Dia. of col = 20"
" " core = 16"
Use 8 – 1" ⌀
" 1/4" □ lateral ties spaced every 12"
Allowable load = 165,600 #
Wt. of col = 417×15 = 6255 # ∴ OK.

3rd to 4th

Load

Same as before	=	64,403
Increase 20%	=	12,881
Load from col. above	=	165,068
Assume wt. of col.	=	11,000
		253,352 #

Square Column

Dia. of col. = 26"
" " core = 22"
Use 6 – 1" ⌀
" 1/4" □ lateral ties spaced every 12"
Allowable load = 255,600 #
Wt. of col. = 704×15 = 10,560 # ∴ OK.

2nd to 3rd

Load

Same as before	=	64,403
Increase 20%	=	12,881
Load from col. above	=	253,352
Assume wt. of col.	=	7,500
		338,136 #

Wt. of col. = 471×15 = 7065 # ∴ OK.

Round Column

Dia. of col. = 24"
" " core = 20"
Use 16 – 7/8" ⌀
Spiral — gage = #3/0
pitch = 2"
ρ = 1.032
Allowable load = 339,900 #

1st to 2nd

Load

Same as before	=	64,403
Increase 20%	=	12,881
Load from col. above	=	338,136
Assume wt. of col.	=	9,500
		424,920 #

Round Column

Dia. of col. = 27"
" " core = 23"
Use 18 – 7/8" ⌀
Spiral — gage = #4/0
pitch = 2 1/8"
ρ = 1.0005
Allowable load = 425,900 #
Wt. of col. = 596×15 = 8940 # ∴ O.K.

Interior Column

5th to 6th

Load

Slab = 20 x 15 x 153 = 45,900
F. Beam = 1667 x 15 x 2 = 50,010
Girder = 240 x 20 = 4,800
100,710
Assume wt. of col 5,000
105,710 #

SQUARE COLUMN
Dia. of col = 17"
" " core = 13"
Use 4 - 1 1/8" ⌀
" 1/4" □ lateral ties spaced 12"
Allowable load = 107,900 #
Wt. of col. = 302 x 15 = 4530 # ∴ O.K.

4th to 5th

Load

Same as before = 100,710
Load from col. above = 105,710
Assume wt. of col. = 9,500
215,920 #

SQUARE COLUMN
Dia. of col. = 24"
" " core = 20"
Use 6 - 1" ⌀
" 1/4" □ lateral ties spaced 12"
Allowable load = 217,800 #
Wt. of col. = 600 x 15 = 9000 # ∴ O.K.

3rd to 4th

Load

Same as before = 100,710
Load from col. above = 215,920
Assume wt. of col. = 7,500
324,130 #

ROUND COLUMN
Dia. of col. = 24"
" " core = 20"
Use 14 - 7/8" ⌀
Spiral - gage = #3/0
pitch = 2"
ρ = 1.032
Allowable load = 324,900 #

Wt. of col. = 471 x 15 = 7065 # ∴ O.K.

2nd to 3rd

Load

Same as before = 100,710
Load from col. above = 324,130
Assume wt. of col. = 10,000
434,840 #

ROUND COLUMN
Dia. of col. = 28"
" " core = 24"
Use 16 - 7/8" ⌀
Spiral - gage = #4/0
pitch = 2"
ρ = 1.013
Allowable load = 436,700 #

Wt. of col. = 641 x 15 = 9615 # ∴ O.K.

1st to 2nd

Load

Same as before = 100,710
Load from col. above = 434,840
Assume wt. of col. = 11,500
547,050 #

ROUND COLUMN
Dia. of col. = 30"
" " core = 26"
Use 18 - 1" ⌀
Spiral - gage = #5/0
pitch = 2 1/4"
ρ = 1.029
Allowable load = 548,000 #
Wt. of col. = 736 x 15 = 11,040 # ∴ O.K.

System 2

		Size	Area Sq-ft.	Number	Length ft.	Volume cu. ft.	
Steel	End Slab	3/8" □	.000979	160	12.5	1.958	
	Int. Slab	3/8" □	.000979	276	15.0	4.04	
Vol.	End F. Beam	5/8" □	.00271	30	18.75	1.525	
	Int. F. Beam	3/4" □	.0039	20	22.5	1.756	
	End Girder	5/8" □	.00271	48	25.0	3.255	
	Int. Girder	5/8" □	.00271	24	30.0	1.951	
	End Span. F. Beam	5/8" □	.00271	8	18.75	.406	
		3/4" □	.0039	4	18.75	.2925	
	Int. Span. F. Beam	3/4" □	.0039	8	22.5	.702	
	End Span Gir.	3/4" □	.0039	12	25.0	1.17	
		7/8" □	.00532	4	25.0	.532	
	Int. Span. Gir.	3/4" □	.0039	8	30.0	.936	
	End. Ext. Col.						18.5235
	5th to 6th	1 1/8" □	.00879	8	17	1.194	
		1/4" □	.00043	30	4.33	.0559	
	4th to 5th	1" □	.00694	12	17	1.415	
		1/4" □	.00043	30	6.67	.0861	
	3rd to 4th	3/4" □	.0039	32	17	2.124	
		Spiral	[.01031 x 2.41 x 15] x 2		=	.746	
	2nd to 3rd	1 1/8" □	.00879	24	17	3.585	
		Spiral	[.010005 x 2.89 x 15] x 2		=	.867	
	1st to 2nd	1" □	.00694	32	17	3.775	
		Spiral	[.01018 x 3.98 x 15] x 2		=	1.215	
	Side Ext. Col.						
	5th to 6th	3/4" □	.0039	48	17	3.182	
		1/4" □	.00043	90	3.67	.1457	
	4th to 5th	1" □	.00694	48	17	5.66	
		1/4" □	.00043	90	5.33	.2062	
	3rd to 4th	1" □	.00694	36	17	4.25	
		1/4" □	.00043	90	7.33	.2835	
	2nd to 3rd	7/8" □	.00532	96	17	8.69	
		Spiral	[.01032 x 2.18 x 15] x 6		=	2.025	
	1st to 2nd	7/8" □	.00532	108	17	9.76	
		Spiral	[.010005 x 2.89 x 15] x 6		=	2.6	
	Int. Col.						
	5th to 6th	1 1/8" □	.00879	16	17	2.39	
		1/4" □	.00043	60	4.33	.1119	
	4th to 5th	1" □	.00694	24	17	2.83	
		1/4" □	.00043	60	6.67	.172	
	3rd to 4th	7/8" □	.00532	56	17	5.065	
		Spiral	[.01032 x 2.18 x 15] x 4		=	1.351	
	2nd to 3rd	7/8" □	.00532	64	17	5.79	
		Spiral	[.01013 x 3.14 x 15] x 4		=	1.91	
	1st to 2nd	1" □	.00694	72	17	8.495	
		Spiral	[.01029 x 3.69 x 15] x 4		=	2.28	
							82.2603

System 2

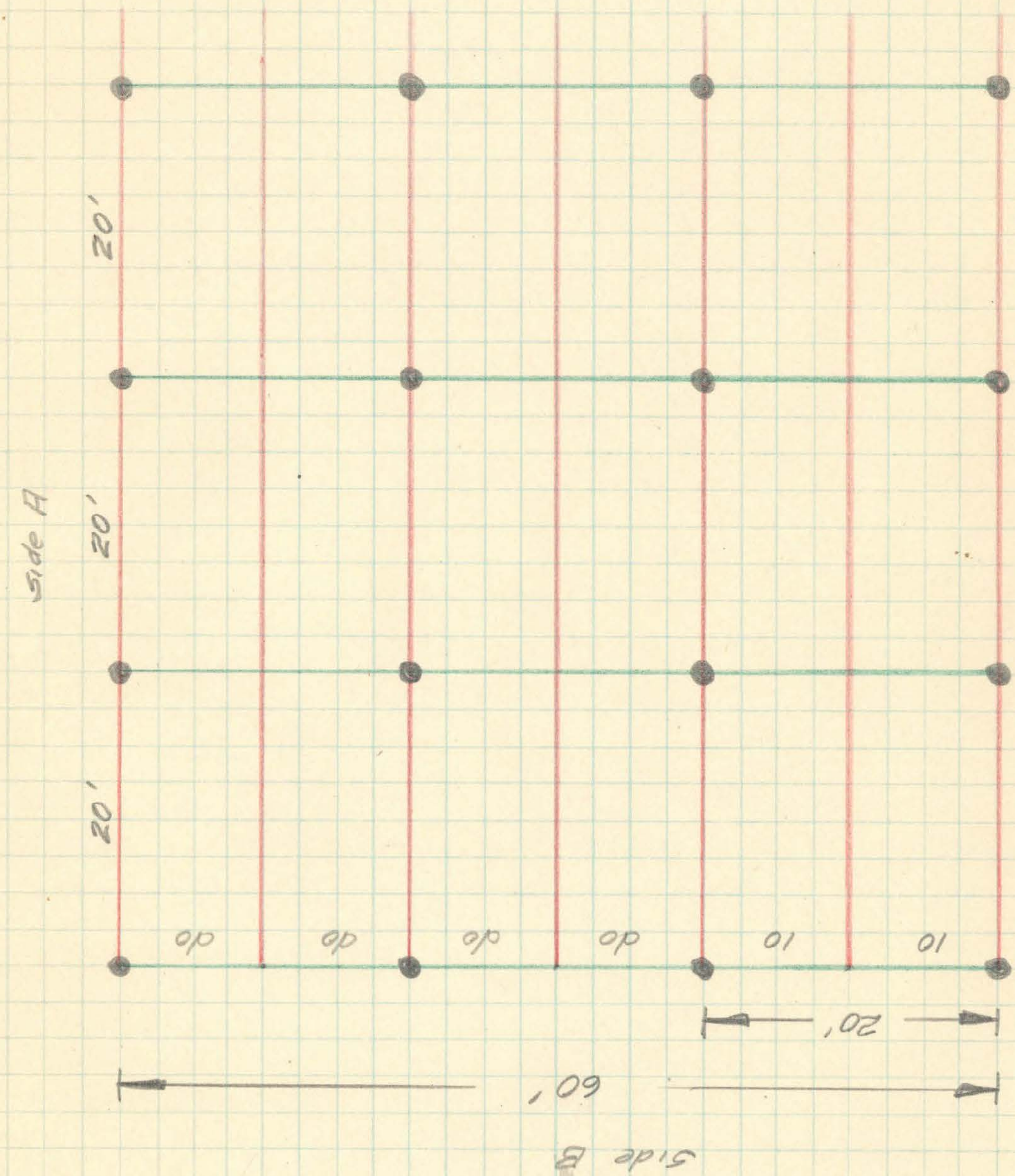
Concrete Volume

	Cross-Sec. Area Sq-inches	X-Sec. A Sq-ft.	Num	Length ft.	Volume cu.-ft.	
End Slab	4.75x360=1710	11.87	2	10	237.4	
Int. Slab	4.25x360=1530	10.61	4	10	424.4	
End F. Beam	10.25x10 = 102.5	.712	5	15	53.4	
Int. F. Beam	10.25x9 = 92.3	.641	5	15	48.0	
End Girder	17.75x13 = 230.7	1.6	4	20	128.0	
Int. Girder	17.75x13 = 230.7	1.6	2	20	64.0	
End Span. F.B.	10.25x12 = 123.0	.854	2	15	25.62	
Int. Span. F.B.	10.25x12 = 123.0	.854	2	15	25.62	
End Span. Gir.	20x12 = 240.0	1.667	2	20	66.7	
Int. Span. Gir.	20x12 = 240.0	1.667	1	20	33.4	
						1106.54

	Size		Vol. c.f./ft.	Num	Len.	Vol.	
End Ext. Col.	Col	Core					
5th to 6th	17"-13"	□	2.01	2	15	60.3	
4th to 5th	24"-20"	□	4.00	2	15	120.0	
3rd to 4th	25"-21"	○	3.41	2	15	102.3	
2nd to 3rd	27"-23"	○	3.98	2	15	119.4	
1st to 2nd	31"-27"	○	5.24	2	15	157.2	
Side Ext. Col							
5th to 6th	15"x11"	□	1.56	6	15	140.4	
4th to 5th	20"x16"	□	2.78	6	15	250.2	
3rd to 4th	26"x22"	□	4.69	6	15	422.1	
2nd to 3rd	29"x20"	○	3.14	6	15	282.6	
1st to 2nd	27"x23"	○	3.98	6	15	358.2	
Interior Col.							
5th to 6th	17"x13"	□	2.01	4	15	120.6	
4th to 5th	24"x20"	□	4.00	4	15	240.0	
3rd to 4th	24"x20"	○	3.14	4	15	188.4	
2nd to 3rd	28"x24"	○	4.28	4	15	256.8	
1st to 2nd	30"x26"	○	4.91	4	15	294.6	
							3113.10

SYSTEM NO.3

SYSTEM NO. 3



End Slab

Live load = 100
Dead " = 60
Total = 160 #/□'

$d^2 = \frac{19,200}{.0077 \times 16000 \times .874 \times 12} = 14.84$ □"

$d = 3.855$" Say 4"
Take $\frac{3}{4}$" below steel

As/ft. of breadth = .0077 x 12 x 4 = .37 □"
Use $\frac{3}{8}$" ϕ spaced every $4\frac{1}{2}$" c. on c.

Moment at center —
$\frac{1}{10} \times 160 \times (10)^2 \times 12 = 19,200$ "#

Check on dead load —
4.75 x 12 x 1.04 = 59.3 #/□'
∴ O.K. Total = 160 #/□'

Shear at end / ft. of breadth
5 x 160 = 800 #
Allowable shear —
40 x 12 x 4 = 1920 #
∴ No web reinforcement.

Intermediate Slab

Live load = 100
Dead " = 60
Total = 160 #/□'

$d^2 = \frac{16000}{.0077 \times 16000 \times .874 \times 12} = 12.4$ □"

$d = 3.52$" Say $3\frac{1}{2}$"
Take $\frac{3}{4}$" below steel

As/ft. of breadth = .0077 x $3\frac{1}{2}$ x 12 = .3235 □"
Use $\frac{3}{8}$" ϕ spaced every $5\frac{1}{4}$" c. on c.

Moment at center —
$\frac{1}{12} \times 160 \times (10)^2 \times 12 = 16000$ "#

Check on dead load —
4.25 x 12 x 1.04 = 53 #/□'
∴ O.K. Total = 153 #/□'

Shear at end / ft. of breadth —
5 x 153 = 765 #
Allowable shear —
40 x 12 x 3.5 = 1680 #
∴ No web reinforcement

MIMEO #1

6-1

$M_{\frac{1}{10}} = \frac{1}{10} \times 1791 \times (20)^2 \times 12 = 860,080$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do = 430,000 "#

MIMEO #2

6-2

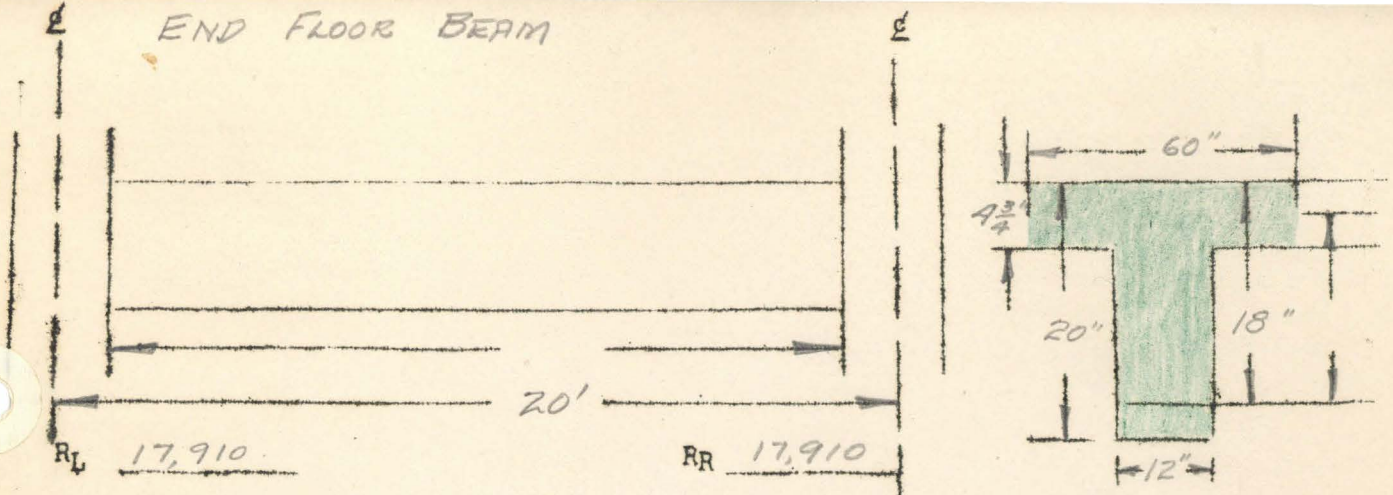
$M_{\frac{1}{10}} = \frac{1}{10} \times 1775 (20)^2 \times 12 = 852,000$ "#
$M_{\frac{1}{12}} = \frac{1}{12}$ do = 710,000 "#

MIMEO #3

6-3

Concentrated Moment = 35660 x 5 x 12 = 2,139,600 "#
$M_{\frac{1}{10}} = 2,139,600 \times \frac{8}{10} = 1,711,680$ "#
$M_{\frac{1}{20}} =$ do $\times \frac{8}{20} = 855,840$ "#
Uni f. Moment — Wt. of stem = 305 #
$M_{\frac{1}{10}} = \frac{1}{10} \times 305 \times (20)^2 \times 12 = 140,800$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do = 70,400 "#
Total Moment —
$M_{\frac{1}{10}} = 1,852,480$ "#
$M_{\frac{1}{20}} = 926,240$ "#

END FLOOR BEAM



Uniform Load per Foot
Slab 10x160 = 1600
Stem 15.25x12x1.04 = 191.

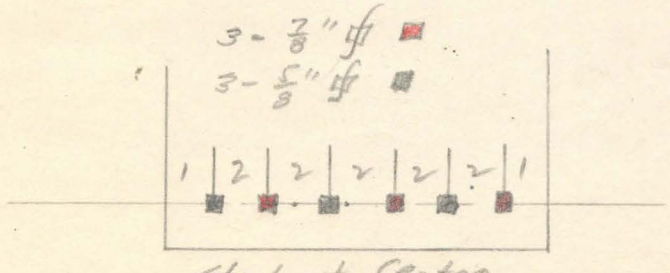
Max. Unit Shear= 96 #/o"
Stirrups No = 9
l' = 70".
Spacing = 2¾ - 8 - 13½ - 19¾ - 26½ - 34 - 41¾ - 51 - 62½

Total Unif.Load= 35820 = 20 x 1791
Conc. Loads =
Total Load =
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/10	M Coef.	1/10	1/20
M = 860,000 "#	M at ℄ of support	860,000 "#	430,000 "#
M/bd2 = M/60x(18)² = 44.3	M at face support	"#	"#
p = 60 "	M/bd²	M/12x(18)² = 221.5	M/12x(18)² = 110.8
d = 18 "	Steel top	3.415 sq."	sq."
t/d = 4.75/18 = .2635	p	.0158	
fc = 375 #/sq."	p'	.0113	
jd = .913x18 = 16.45 "	M/bd² allowable	133.5	133.5
As = .0031x60x18 = 3.35 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 3-⅞" ℄ = 3.47 sq."	Length to develop	16 "	"
	Bond Stress	120 #/sq."	#/sq."
p = .0031	Steel bottom	2.44 sq."	sq."

Bend 3-⅞" ℄ over right support.



Steel at Center

MARK 6-1

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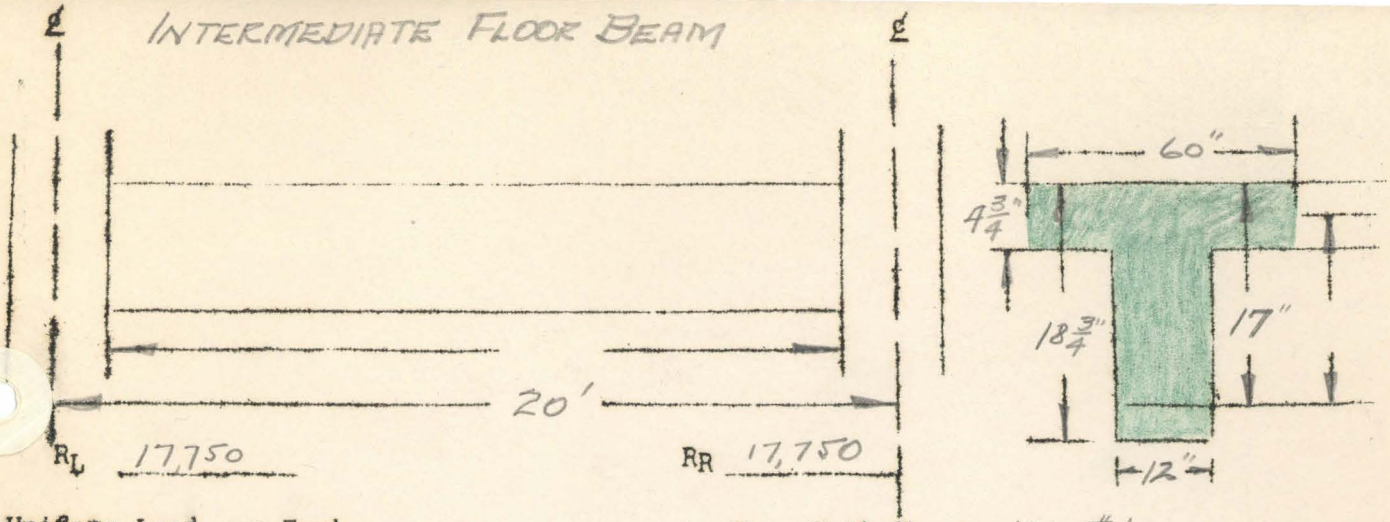
MIMEO #1

INTERMEDIATE FLOOR BEAM



Uniform Load per Foot
Slab 10 x 160 = 1600
Stem 14 x 12 x 1.04 = 175

Total Unif. Load = 35500 = 20 x 1775
Cono. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear = 100 #/d"
Stirrups No = 9
l' = 72"
Spacing = $2\frac{3}{4}$ - 8 - 14 - $20\frac{1}{2}$ - $27\frac{1}{2}$ - 35 - 43 - $52\frac{3}{4}$ - $64\frac{1}{2}$

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = 1/12	M Coef.	1/12	1/10
M = 710,000 "#	M at ℄ of support	710,000 "#	852,000 "#
M/bd2 = M/60 x (17)² = 41	M at face support	"#	"#
b = 60 "	M/bd²	M/12 x (17)² = 205	M/12 x (17)² = 246
d = 17 "	Steel top	3.0 sq."	3.57 sq."
t/d = 4.75/17 = .279	p	.0147	.0175
fo = 355 #/sq."	p'	.0093	.0146
jd = .916 x 17 = 15.59 "	M/bd² allowable	133.5	133.5
As = .00285 x 60 x 17 = 2.91 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 6 - $\frac{3}{4}$" ℄ = 3.375 sq."	Length to develop	14 "	14 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .00285	Steel bottom	1.898 sq."	2.98 sq."

Steel spacing same as shown on MIMEO #1
Bend 4 - $\frac{3}{4}$" ℄ over left support
" 3 - $\frac{3}{4}$" ℄ " right "
c

MARK 6-2

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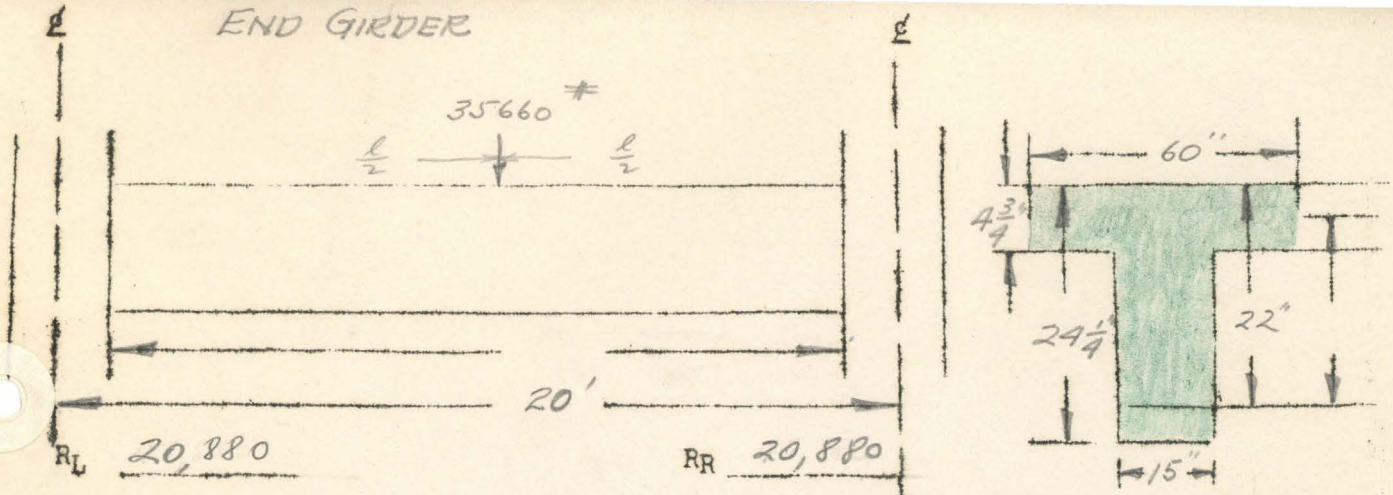
MIMEO #2

END GIRDER



R_L 20,880 R_R 20,880

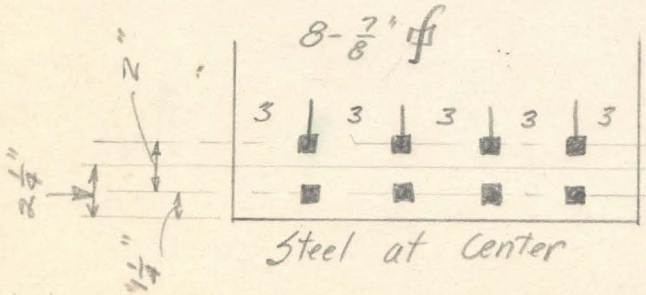
Uniform Load per Foot
Slab =
Stem 19.50×15×1.04 = 305

Total Unif.Load= 6100 = 20 x 305
Conc. Loads = 35660
Total Load = 41,760
Equiv. Load =

Max. Unit Shear= 74 #/d"
Stirrups No = 7
l' = 55"
Spacing = 3-9¼-16-23½-31¾-40¼-50

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= 1/10	M Coef.	1/10	1/20
M = 1,852,480 "#	M at ℄ of support	1,852,480 "#	926,240 "#
M/bd2 = M/60x(22)² = 63.8	M at face support	"#	"#
b = 60 "	M/bd²	M/15x(22)² = 255	M/15x(22)² = 128
d = 22 "	Steel top	6.005 sq."	sq."
t/d = 4.75/22 = .216	p	.0182	
fo = 500 #/sq."	p'	.0158	
jd = .9105x22 = 20.05 "	M/bd² allowable	133.5	133.5
As = .0043x60x22 = 5.68 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 8-⅞"ff = 6.125 sq."	Length to develop	16 "	"
	Bond Stress	120 #/sq."	#/sq."
p = .0043	Steel bottom	5.22 sq."	sq."



Steel at Center

MARK 6-3

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MIMEO #3

MIMEO #4 — 6-1

Conc $M_{\frac{1}{12}} = \frac{8}{12} \times 2{,}139{,}600 = 1{,}426{,}400$ "#
Unif $M_{\frac{1}{12}} = \frac{1}{12} \times 305 \times (20)^2 \times 12 = 122{,}000$ "#

Total $M_{\frac{1}{12}} = 1{,}548{,}400$ "#

MIMEO #5 — 6-5

$M_{\frac{1}{10}} = \frac{1}{10} \times 1991 \times (20)^2 \times 12 = 957{,}000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 478{,}500$ "#

MIMEO #6 — 6-6

$M_{\frac{1}{12}} = \frac{1}{12} \times 1991 \times (20)^2 \times 12 = 796{,}400$ "#

MIMEO #7 — 6-7

Concentrated Moment $= 8955 \times 10 \times 12 = 1{,}075{,}000$ "#
$M_{\frac{8}{10}} = \frac{8}{10} \times 1{,}075{,}000 = 860{,}000$ "#
$M_{\frac{8}{20}} = \frac{8}{20}$ do $= 430{,}000$ "#
$M_{\frac{8}{12}} = \frac{8}{12}$ do $= 717{,}500$ "#
Unif. Moment —
$M_{\frac{1}{10}} = \frac{1}{10} \times 2155 \times (20)^2 \times 12 = 1{,}035{,}000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 517{,}500$ "#

Total Moment —
$M_{\frac{1}{10}} = 1{,}895{,}000$ "#
$M_{\frac{1}{20}} = 947{,}500$ "#

MIMEO #8 — 6-8

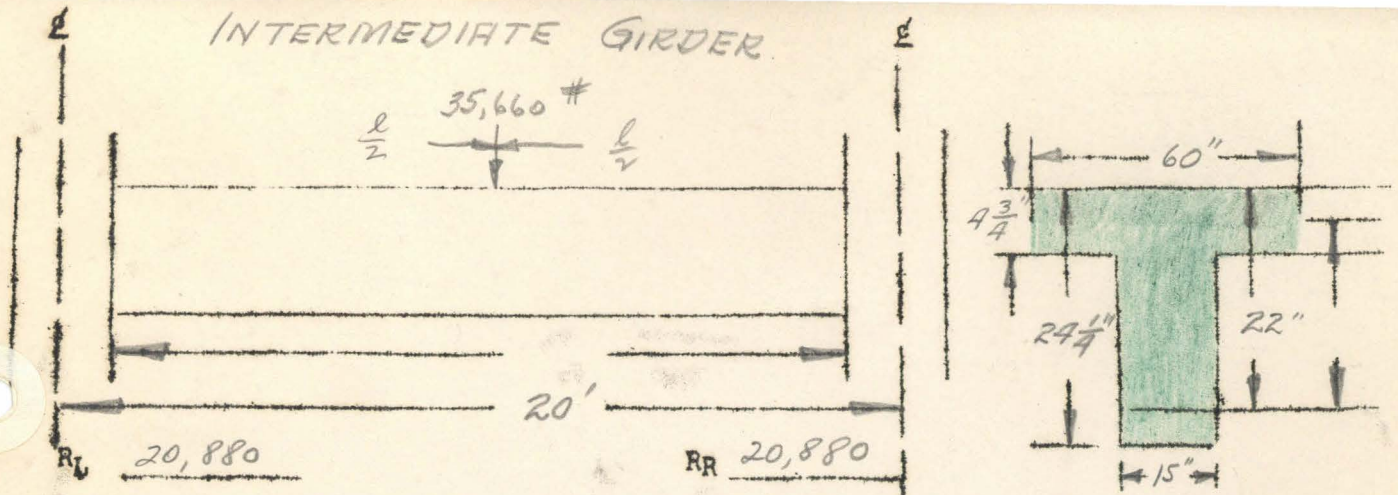
Concentrated Moment same as for 6-7
Unif. Moment —
$M_{\frac{1}{10}} = \frac{1}{10} \times 2163 \times (20)^2 \times 12 = 1{,}040{,}000$ "#
$M_{\frac{1}{12}} = \frac{1}{12}$ do $= 866{,}000$ "#

Total Moment —
$M_{\frac{1}{10}} = 1{,}900{,}000$ "#
$M_{\frac{1}{12}} = 1{,}583{,}500$ "#

Unit Shear $\qquad \checkmark = .87$

$$v = \frac{30{,}585}{.87 \times 15 \times 25} = 93.7 \ \#/\square"$$

INTERMEDIATE GIRDER



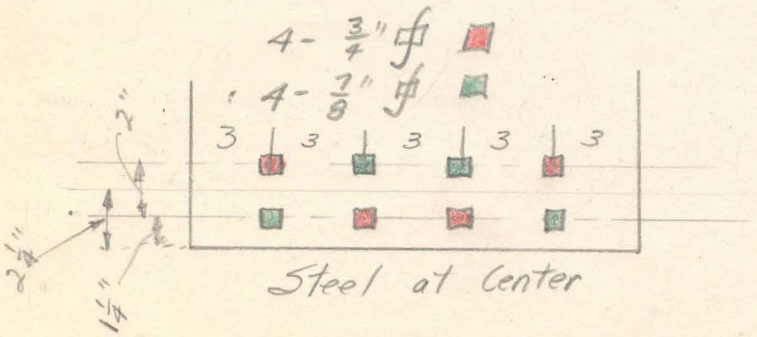
Uniform Load per Foot
Slab =
Stem 19.50x15x1.04 = 305

Max. Unit Shear = 74 #/□"
Stirrupe No = 7
1' = 55"
Spacing = 3-9 1/4-16-23 1/2-31 3/4-40 1/4-50

Total Unif. Load = 6100 = 20 x 305
Conc. Loads = 35660
Total Load = 41,760
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/12		M Coef.	1/12	1/10
M = 1,548,400	"#	M at ℄ of support	1,548,400 "#	1,852,480 "#
M/bd2 = M/60x(22)² = 53.3		M at face support	"#	"#
b = 60	"	M/bd²	M/15x(22)² = 213.2	M/15x(22)² = 255
d = 22	"	Steel top	5.05 sq."	6.005 sq."
t/d = 4.75/22 = .216		p	.0153	.0182
f_o = 430	#/sq."	p'	.0103	.0158
jd = .915x22 = 20.15	"	M/bd² allowable	133.5	133.5
As = .0037x60x22 = 4.89	sq."	f' steel	8550 #/sq."	8550 #/sq."
Steel = 4-3/4" sq = 5.31	sq."	Length to develop	16 "	16 "
		Bond Stress	120 #/sq."	120 #/sq."
p = .0037		Steel bottom	3.4 sq."	5.22 sq."



Steel at Center

MARK 6-A

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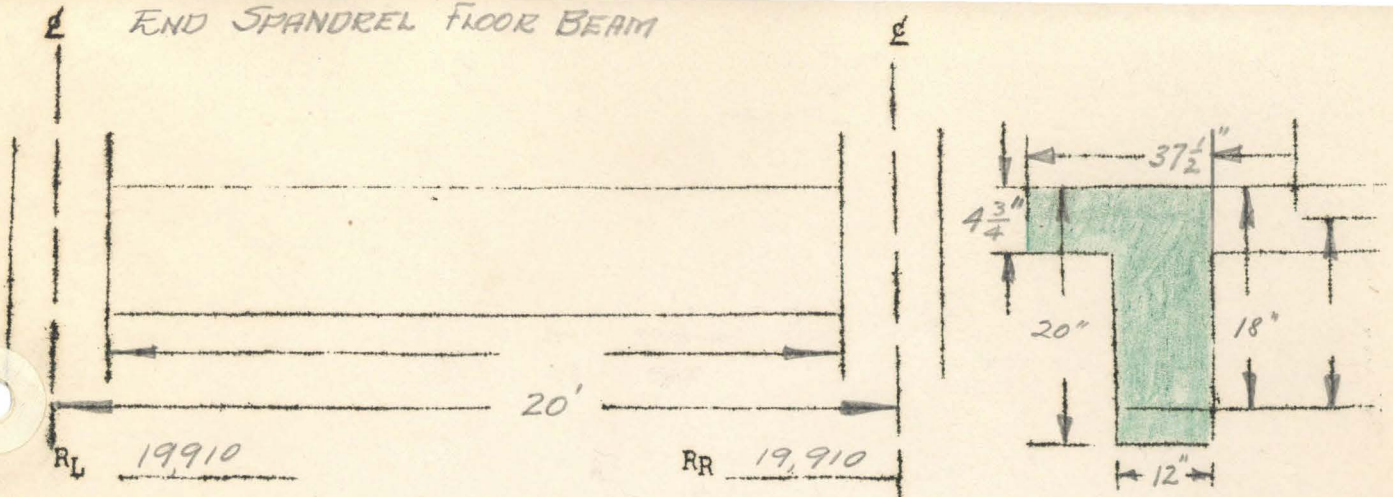
MIMEO #4

℄ END SPANDREL FLOOR BEAM ℄



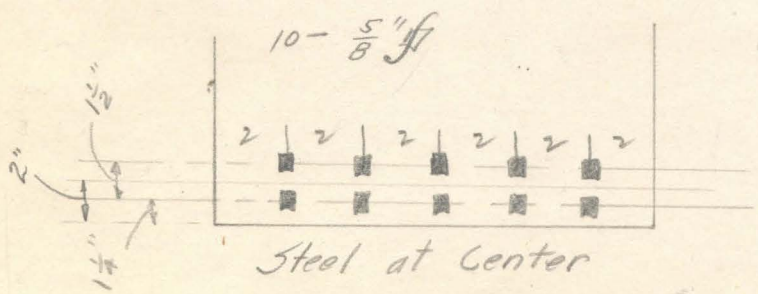
Uniform Load per Foot
Slab =
Stem 15.25x12x1.04 = 191
Brick Wall = 120x15 = 1800

Total Unif.Load= 39820 = 20 x 1991
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear= 107 #/0"
Stirrups No = 10
l' = 79"
Spacing = 3-7-$12\frac{3}{4}$-$18\frac{1}{2}$-$25\frac{1}{2}$-$32\frac{3}{4}$-$40\frac{1}{2}$-49-59-$71\frac{1}{4}$

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef.= $\frac{1}{10}$	M Coef.	$\frac{1}{10}$	$\frac{1}{20}$
M = 957,000 "#	M at ℄ of support	957,000 "#	478,500 "#
M/bd2 = M/(37.5)(18)^2 = 78.9	M at face support	"#	"#
b = 37.5 "	M/bd^2	M/12x(18)^2 = 246	M/12x(18)^2 = 123
d = 18 "	Steel top	3.78 sq."	sq."
t/d = 4.75/18 = .264	p	.0175	
fc = 550 #/sq."	p'	.0146	
jd = .8995x18 = 16.01 "	M/bd^2 allowable	133.5	133.5
As = .0048x37.5x18 = 3.24 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 10-$\frac{5}{8}$"ℓℓ = 3.906 sq."	Length to develop	14 "	"
	Bond Stress	120 #/sq."	120 #/sq."
p = .0048	Steel bottom	3.155 sq."	sq."



Steel at Center

MARK 6-5

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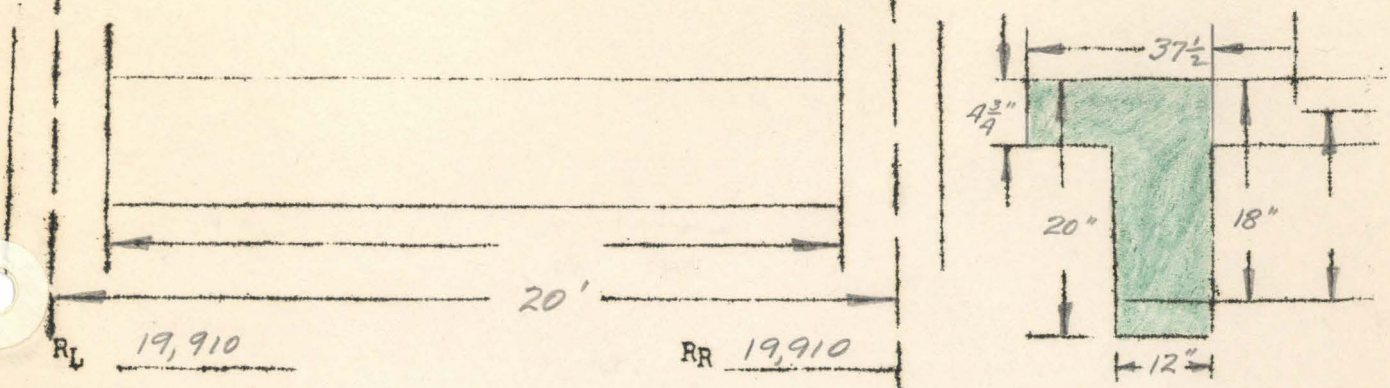
MIMEO #5

℄ INTERMEDIATE SPANDREL FLOOR BEAM ℄



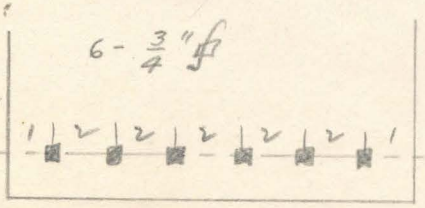
Uniform Load per Foot
Slab =
Stem 15.25×12×1.04 = 191
Brick Wall = 120×15 = 1800

Total Unif. Load = 39820 = 20 x 1991
Cono. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear = 107 #/□"
Stirrups No = 10
l' = 79"
Spacing = 3-7-12¾-18½-25½-32¾-40½-49-59-71¼

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = 1/12	M Coef.	1/12	1/10
M = 796,400 "#	M at ℄ of support	796,400 "#	957,000 "#
M/bd2 = M/(37.5)(18)² = 65	M at face support	"#	"#
b = 37.5 "	M/bd²	M/12×(18)² = 205	M/12×(18)² = 246
d = 18 "	Steel top	3.18 sq."	3.78 sq."
t/d = 4.75/18 = .264	p	.0147	.0175
fo = 475 #/sq."	p'	.0092	.0146
jd = .901×18 = 16.2 "	M/bd² allowable	133.5	133.5
As = .0045×37.5×18 = 3.04 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 6-¾"ϕ = 3.375 sq."	Length to develop	14 "	14 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0045	Steel bottom	1.99 sq."	3.155 sq."



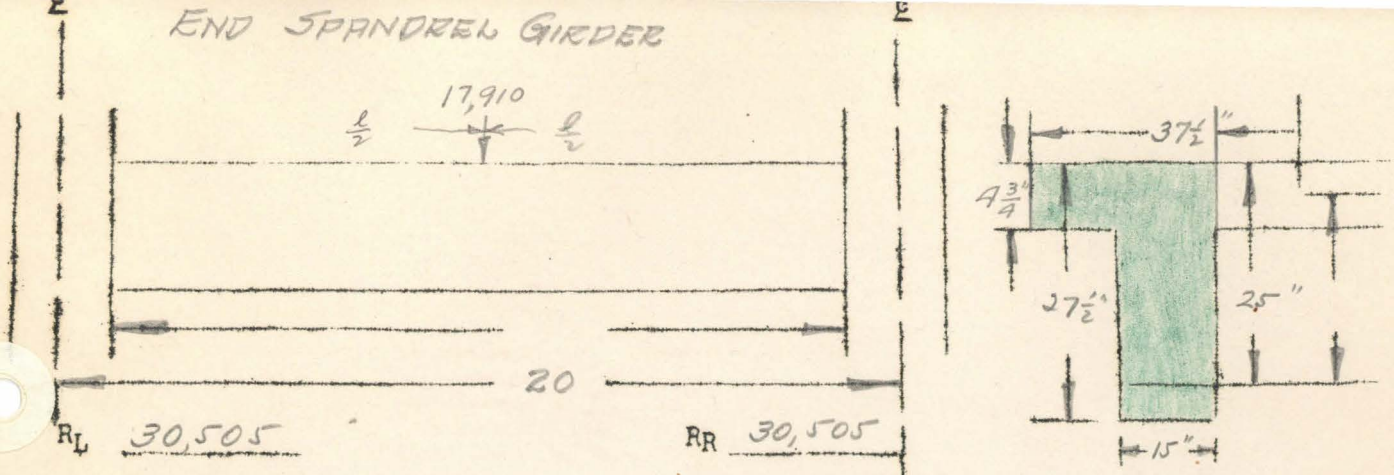
Steel at Center

MARK 6-6

Computed H.V.G.	Date 5/24/24
Checked	Detailed
Work Order Th 100	Page No.

MIMEO #6

END SPANDREL GIRDER



Uniform Load per Foot
Slab =
Stem 22.75 x 15 x 1.04 = 355
Brick Wall = 120 x 15 = 1800

Max. Unit Shear = 93.5 #/10"
Stirrups No =
1' =
Spacing =

Total Unif. Load = 43100 = 20 x 2155
Conc. Loads = 17910
Total Load = 61010
Equiv. Load =

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/10	1/20
M = 1,895,000	"#	M at ℄ of support	1,895,000 "#	947,500 "#
M/bd2 = M/(37.5)(25)² = 81		M at face support	"#	"#
b = 37.5	"	M/bd²	M/15x(25)² = 202	M/15x(25)² = 101
d = 25	"	Steel top	5.44 sq."	sq."
t/d = 4.75/25 = .19		p	.0145	
f_o = 630	#/sq."	p'	.009	
jd = .917 x 25 = 22.95	"	M/bd² allowable	133.5	133.5
As = .0055 x 37.5 x 25 = 5.16 sq."		f' steel	8550 #/sq."	#/sq."
Steel = 10-¾" ℄ = 5.625 sq."		Length to develop	14 "	"
		Bond Stress	120 #/sq."	120 #/sq."
p = .0055		Steel bottom	3.375 sq."	sq."

MARK 6-7

Computed H.V.G.	Date 5/24/24
Checked	Detailed
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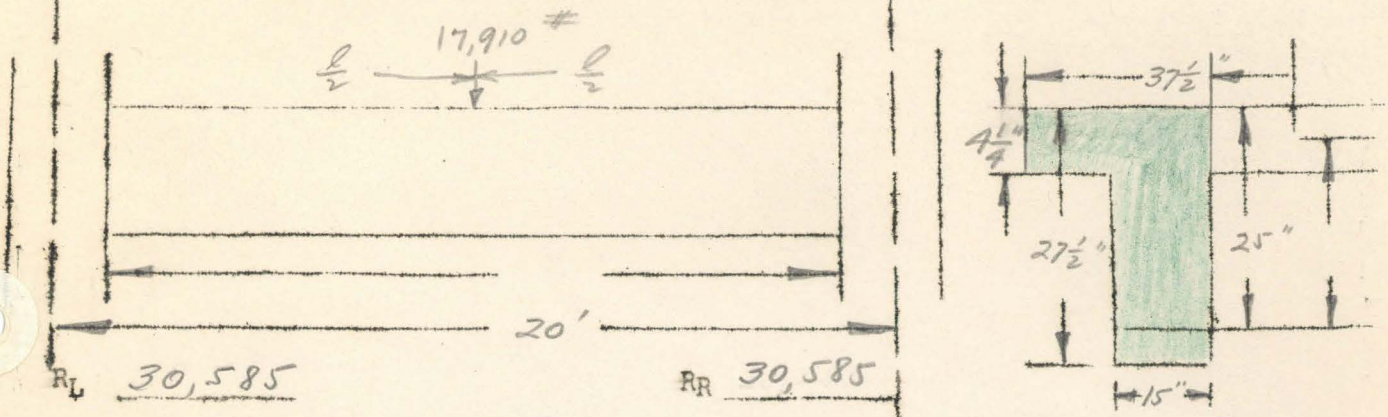
MIMEO #7

℄ INTERMEDIATE SPANDREL GIRDER ℄



Uniform Load per Foot
Slab =
Stem 23.25 x 15 x 1.04 = 363
Brick Wall = 1800

Total Unif. Load = 43260 = 20 x 2163
Conc. Loads = 17910
Total Load = 61170
Equiv. Load =

Max. Unit Shear = 93.7 #/□"
Stirrups No = 10
l' = 69"
Spacing = 2½ - 6 - 11 - 16 - 22 - 28¾ - 35½ - 43 - 52 - 62½

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = 1/12	M Coef.	1/12	1/10
M = 1,583,500 "#	M at ℄ of support	1,583,500 "#	1,900,000 "#
M/bd2 = M/(37.5)(25)² = 67.6	M at face support	"#	"#
b = 37.5 "	M/bd²	M/15x(25)² = 169	M/15x(25)² = 203
d = 25 "	Steel top	4.58 sq."	5.48 sq."
t/d = 4.25/25 = .17	p	.0122	.0146
fc = 570 #/sq."	p'	.0047	.0091
jd = .923 x 25 = 23.1 "	M/bd² allowable	133.5	133.5
As = .0046 x 37.5 x 25 = 4.31 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel = 12-⅝"ℓ = 4.687 sq."	Length to develop	12 "	12 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0046	Steel bottom	1.764 sq."	3.41 sq."

MARK 6-8

Computed H.K.G.	Date 6/24/24
Checked	Detailed
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MIMEO #8

Exterior Column — Side A

5th to 6th

Load

Slab = 10 x 160 x 20	= 32,000	
F. Beam = 183 x 10	= 1830	
Girder = 305 x 10	= 3050	
Spandrel = 1991 x 20	= 39820	
	76,700 #	
20% for ecc.	= 15,340	
Wt. of col.	= 5,000	
	97,040 #	

SQUARE COLUMN

Dia. of Col = 17"
" " core = 13"
Use 6 - $\frac{3}{4}$" ⌀
Use $\frac{1}{4}$" □ lateral ties spaced 12"
Allowable load = 97,300 #
Wt. of column = 302 x 15 = 4530 # ∴ O.K.

4th to 5th

Load

Same as before =	76,700
Increase 20% =	15,340
Load from Col. above =	97,040
Wt. of col =	8500
	197,580 #

SQUARE COLUMN

Dia. of col = 23"
" " core = 19"
Use 6 - 1" ⌀
" $\frac{1}{4}$" □ lateral ties spaced 12"
Allowable load = 200,300 #
Wt. of col. = 552 x 15 = 8280 # ∴ O.K.

3rd to 4th

Load

Same as before =	76,700
Increase 20% =	15,340
Load from col. above =	197,580
Wt. of col. =	7,000
	296,620

ROUND COLUMN

Dia. of col. = 23"
" " core = 19"
Use 10 - 1" ⌀
Spiral — gage = #4/0 p = 1.0005
pitch = $2\frac{1}{8}$"
Allowable load = 296,500 #
Wt. of col. = 433 x 15 = 6495 # ∴ O.K.

2nd to 3rd

Load

Same as before =	76,700
Increase 20% =	15,340
Load from col. above =	296,620
Assume wt. of col. =	8,500
	397,160 #

ROUND COLUMN

Dia. of col. = 26"
" " core = 22"
Use 18 - $\frac{7}{8}$" ⌀
Spiral — gage = #4/0 p = 1.045
pitch = $2\frac{1}{8}$"
Allowable load = 401,100 #
Wt. of Col. = 553 x 15 = 8295 # ∴ OK.

1st to 2nd

Load

Same as before =	76,700
Increase 20% =	15,340
Load from col. above =	397,160
Assume wt. of col. =	10,500
	499,700 #

ROUND COLUMN

Dia. of col. = 29"
" " core = 25"
Use 16 - 1" ⌀
Spiral — gage = #6/0 p = 1.027
pitch = $2\frac{1}{4}$"
Allowable load = 500,400 #
Wt. of col. = 688 x 15 = 10,320 #

Exterior Column – Side B

5th to 6th

Load

Slab = 10x153x20	= 30,600
F.Beam = 191x20	= 3,820
Spandrel = 2159x20	= 43,180
	77,600 #
Increase 20% for ecc.	15,532
Wt. of column	5,000
	98,132 #

SQUARE COLUMN

Dia. of col. = 17"
" " core = 13"
Use 4 - 1" ⌀
" ¼"□ lateral ties spaced 12"
Allowable load = 101,300 #
Wt. of col. = 302x15 = 4530 #, ∴ OK.

4th to 5th

Load

Same as before	= 77,600
Increase 20%	= 15,532
Load from col. above	= 98,132
Assume wt. of col.	= 8,500
	199,764 #

SQUARE COLUMN

Dia. of col. = 23"
" " core = 19"
Use 6 - 1" ⌀
" ¼"□ lateral ties spaced 12"
Allowable load = 200,300 #
Wt. of col. = 552x15 = 8280 #, ∴ OK.

3rd to 4th

Load

Same as before	= 77,600
Increase 20%	= 15,532
Load from col. above	= 199,764
Assume wt. of col.	= 6,750
	299,646 #

ROUND COLUMN

Dia. of col. = 23"
" " core = 19"
Use 14 - ⅞" ⌀
Spiral – gage = #4/0 ρ = 1.0005
pitch = 2⅛"
Allowable load = 303,500 #
Wt. of col. = 433x15 = 6495 #, ∴ OK.

2nd to 3rd

Load

Same as before	= 77,600
Increase 20%	= 15,532
Load from col. above	= 299,646
Assume wt. of col.	= 8,500
	401,278

ROUND COLUMN

Dia. of col. = 26"
" " core = 22"
Use 18 - ⅞" ⌀
Spiral – gage = #4/0 ρ = 1.045
pitch = 2⅛"
Allowable load = 401,100 #
Wt. of col. = 553x15 = 8295 #, ∴ OK.

1st to 2nd

Load

Same as before	= 77,600
Increase 20%	= 15,532
Load from col. above	= 401,278
Assume wt. of col.	= 11,500
	505,910

ROUND COLUMN

Dia. of col. = 30"
" " core = 26"
Use 18 - ⅞" ⌀
Spiral – gage = #5/0
pitch = 2⅛"
ρ = 1.057
Allowable load = 506,600 #
Wt. of col. = 736x15 = 11,040 #, ∴ OK.

Interior Columns

5th to 6th

Load

Slab = 153 x 20 x 20 = 61,200
F.Beam = 183 x 20 x 2 = 7,320
Girder = 305 x 20 = 6,100
74,620 #
Assume wt. of col. = 4,000
78,620 #

SQUARE COLUMN
Dia. of col. = 15"
" " core = 11"
Use 4 - 1" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 79,700 #
Wt. of col. = 234 x 15 = 3510 # ∴ O.K.

4th to 5th

Load

Same as before = 74,620
Load from col. above = 78,620
Assume wt. of col = 7,000
160,240 #

SQUARE COLUMN
Dia. of col. = 21"
" " core = 17"
Use 4 - 1⅛" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 161,900 #
Wt. of col. = 459 x 15 = 6885 # ∴ O.K.

3rd to 4th

Load

Same as before = 74,620
Load from col. above = 160,240
Assume wt. of col. = 6250
241,110 #

Wt. of col. = 396 x 15 = 5940 # ∴ O.K.

ROUND COLUMN
Dia. of col. = 22"
" " core = 18"
Use 12 - ¾" ⌀

Spiral — gage = #3/0 p = 1.020
pitch = 2½"
Allowable load = 244,400

2nd to 3rd

Load

Same as before = 74,620
Load from col. above = 241,110
Assume wt. of col. = 7,500
323,230 #

Wt. of col. = 471 x 15 = 7065 # ∴ O.K.

ROUND COLUMN
Dia. of col. = 24"
" " core = 20"
Use 14 - ⅞" ⌀
Spiral — gage = #3/0 p = 1.032
pitch = 2"
Allowable load = 324,900 #

1st to 2nd

Load

Same as before = 74,620
Load from col. above = 323,230
Assume wt. of col. = 9,000
406,850 #

ROUND COLUMN
Dia. of col. = 27"
" " core = 23"
Use 12 - 1" ⌀
Spiral — gage = #4/0
pitch = 2⅛"
p = 1.0005
Allowable load = 408,500 #
Wt. of col. = 596 x 15 = 8940 # ∴ O.K.

System 3

Steel Volume		Size	Area Sq-ft.	Number	Length ft.	Volume cu.-ft.	
	End Slab	3/8" □	.000979	214	12.5	2.62	
	Int. Slab	3/8" □	.000979	366	15.0	5.38	
	End F. Beam	5/8" □	.00271	15	25.0	1.017	
		7/8" □	.00532	15	25.0	1.998	
	Int. F. Beam	3/4" □	.0039	30	30.0	3.51	
	End Girder	7/8" □	.00532	32	25.0	4.256	
	Int. Girder	3/4" □	.0039	8	30.0	.936	
		7/8" □	.00532	8	30.0	1.278	
	End Span. F.B.	5/8" □	.00271	20	25.0	1.355	
	Int. Span. F.B.	3/4" □	.0039	12	30.0	1.405	
	End Span. Gir.	3/4" □	.0039	20	25.0	1.95	
	Int. Span. Gir.	5/8" □	.00271	12	30.0	.976	
	End Ext. Col.						26.681
	5th to 6th	1" □	.00694	8	17	.944	
		1/4" □	.00043	30	4.33	.0559	
	4th to 5th	1" □	.00694	12	17	1.417	
		1/4" □	.00043	30	6.33	.0816	
	3rd to 4th	7/8" □	.00532	28	17	2.535	
		Spiral	[.010005 x 1.97 x 15] x 2		=	.592	
	2nd to 3rd	7/8" □	.00532	36	17	3.26	
		Spiral	[.01045 x 2.64 x 15] x 2		=	.828	
	1st to 2nd	7/8" □	.00532	36	17	3.26	
		Spiral	[.01057 x 3.69 x 15] x 2		=	1.17	
	Side Ext. Col.						
	5th to 6th	3/4" □	.0039	36	17	2.388	
		1/4" □	.00043	90	4.33	.1676	
	4th to 5th	1" □	.00694	36	17	4.25	
		1/4" □	.00043	90	6.33	.245	
	3rd to 4th	1" □	.00694	60	17	7.08	
		Spiral	[.010005 x 1.97 x 15] x 6		=	1.776	
	2nd to 3rd	7/8" □	.00532	108	17	9.77	
		Spiral	[.01045 x 2.64 x 15] x 6		=	2.484	
	1st to 2nd	1" □	.00694	96	17	11.33	
		Spiral	[.01027 x 3.41 x 15] x 6		=	3.155	
	Interior Col.						
	5th to 6th	1" □	.00694	16	17	1.889	
		1/4" □	.00043	60	3.67	.0946	
	4th to 5th	1 1/8" □	.00879	16	17	2.39	
		1/4" □	.00043	60	5.67	.1463	
	3rd to 4th	3/4" □	.0039	48	17	3.18	
		Spiral	[.0102 x 1.77 x 15] x 4		=	1.085	
	2nd to 3rd	7/8" □	.00532	56	17	5.07	
		Spiral	[.01032 x 2.18 x 15] x 4		=	1.351	
	1st to 2nd	1" □	.00694	48	17	5.66	
		Spiral	[.010005 x 2.89 x 15] x 4		=	1.736	
							79.391

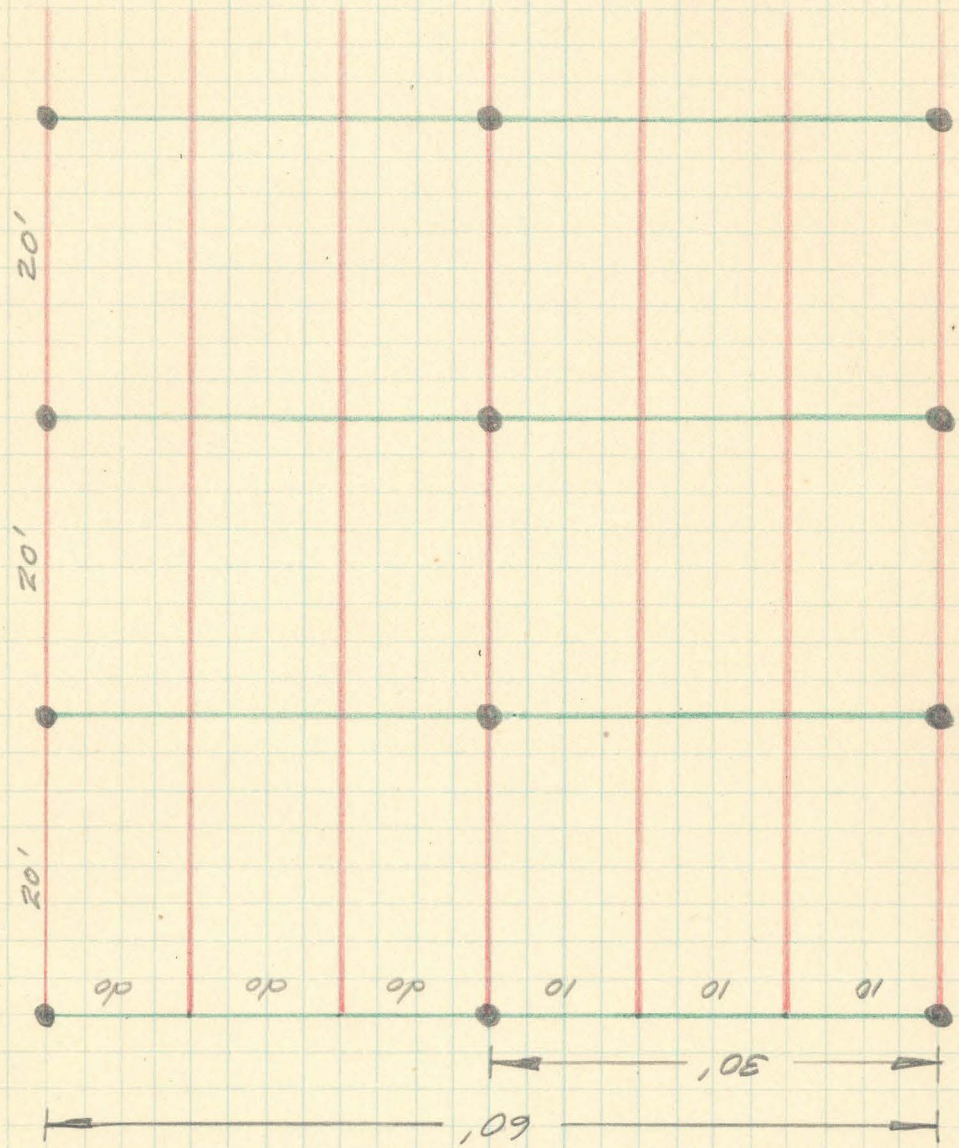
System 3

		Cross-Sec. Area Sq-inches	X-Sec. A Sq-ft.	Num	Length ft.	Volume cu.-ft.	
Concrete Volume	End Slab	4.75x480=2280	15.82	2	10	316.4	
	Int. Slab	4.25x480=2040	14.16	4	10	566.4	
	End F. Beam	15.25x12 = 183	1.27	5	20	127.0	
	Int. F. Beam	14 x12 = 168	1.166	5	20	116.6	
	End Girder	19.5x15 = 293	2.035	4	20	162.8	
	Int. Girder	19.5x15 = 293	2.035	2	20	81.4	
	End Span. F.B.	15.25x12 = 183	1.27	2	20	50.8	
	Int. Span. F.B.	15.25x12 = 183	1.27	2	20	50.8	
	End Span. Gir.	22.75x15 = 341	2.37	2	20	94.8	
	Int. Span. Gir.	23.25x15 = 349	2.422	1	20	48.44	
							1615.44

	Size		Vol. c.f./ft.	Num.	Len.	Volume	
		Col Core					
End Ext. Col.							
5th to 6th	17" - 13"	□	2.01	2	15	60.3	
4th to 5th	23" - 19"	□	3.68	2	15	110.4	
3rd to 4th	23" - 19"	○	2.89	2	15	86.7	
2nd to 3rd	26" - 22"	○	3.69	2	15	110.7	
1st to 2nd	30" - 26"	○	4.91	2	15	143.7	
Side Ext. Col.							
5th to 6th	17" - 13"	□	2.01	6	15	180.9	
4th to 5th	23" - 19"	□	3.68	6	15	331.2	
3rd to 4th	23" - 19"	○	2.89	6	15	260.1	
2nd to 3rd	26" - 22"	○	3.69	6	15	332.1	
1st to 2nd	29" - 25"	○	4.59	6	15	413.1	
Interior Col.							
5th to 6th	15" - 11"	□	1.56	4	15	93.6	
4th to 5th	21" - 17"	□	3.06	4	15	183.6	
3rd to 4th	22" - 18"	○	2.64	4	15	158.4	
2nd to 3rd	24" - 20"	○	3.14	4	15	188.4	
1st to 2nd	27" - 23"	○	3.98	4	15	238.8	
							2892.0

SYSTEM NO.4

SYSTEM NO. 4



End Slab

Live Load = 100
Dead " = 60
Total = 160 #/□'

$d^2 = \frac{19200}{.0077 \times 16000 \times .874 \times 12} = 14.84$ □"

$d = 3.855$" Say 4"
Take ¾" below steel

As / ft. of breadth = .0077 x 12 x 4 = .37 □"
Use ⅜" ϕ spaced 4½" c. on c.

Moment at Center ⌣
$\frac{1}{10} \times 160 \times (10)^2 \times 12 = 19,200$ "#

Check on dead load ⌣
4.75 x 12 x 1.04 = 59.3 #/□'
∴ O.K. Total = 160 #/□'

Shear at end / ft. of breadth
5 x 160 = 800 #
Allowable shear ⌣
40 x 12 x 4 = 1920 #
∴ No web reinforcement.

Intermediate Slab

Live load = 100
Dead " = 60
Total = 160 #/□'

$d^2 = \frac{16000}{.0077 \times 16000 \times .874 \times 12} = 12.4$ □"

$d = 3.52$" Say 3½"
Take ¾" below steel

As / ft. of breadth = .0077 x 3.5 x 12 = .3235 □"
Use ⅜" ϕ spaced 5¼" c. on c.

Moment at Center ⌣
$\frac{1}{2} \times 160 \times (10)^2 \times 12 = 16000$ "#

Check on dead load ⌣
4.25 x 12 x 1.04 = 53 #/□'
∴ O.K. Total = 153 #/□'

Shear at end / ft. of breadth
5 x 153 = 765 #
Allowable Shear ⌣
40 x 12 x 3.5 = 1680 #
∴ No web reinforcement

MIMEO #1

6 - 1

$M_{\frac{1}{10}} = \frac{1}{10} \times 1791 \times (20)^2 \times 12 = 860,000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 430,000$ "#

MIMEO #2

6 - 2

$M_{\frac{1}{10}} = \frac{1}{10} \times 1775 \times (20)^2 \times 12 = 852,000$ "#
$M_{\frac{1}{12}} = \frac{1}{12}$ do $= 710,000$ "#

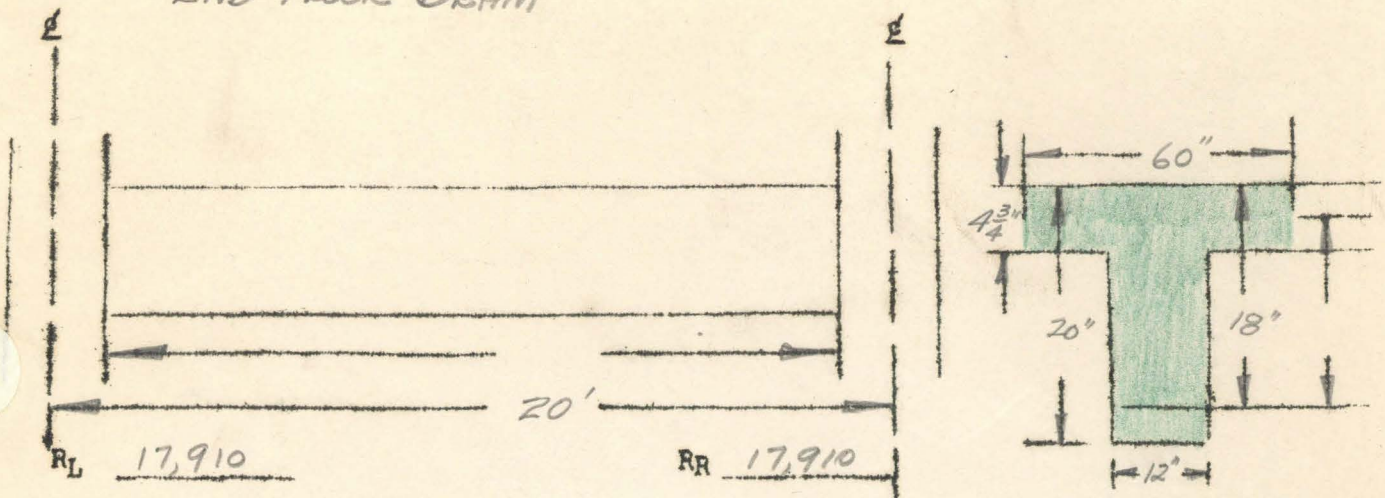
MIMEO #3

6 - 3

Concentrated Moment ⌣ $35,660 \times 10 \times 12 = 4,279,200$ "#
$M_{\frac{1}{8}} = \frac{8}{8} \times 4,279,200 = 4,279,200$ "#
$M_{\frac{1}{10}} = \frac{8}{10}$ do $= 3,423,360$ "#
$M_{\frac{1}{20}} = \frac{8}{20}$ do $= 1,711,680$ "#

Unif Moment ⌣ wt. of stem = 624 #/ft.
$M_{\frac{1}{8}} = \frac{1}{8} \times 624 \times (30)^2 \times 12 = 843,000$ "#
$M_{\frac{1}{10}} = \frac{1}{10}$ do $= 674,000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 337,000$ "#

END FLOOR BEAM



Uniform Load per Foot
Slab 10 x 160 = 1600
Stem 15.25 x 12 x 1.04 = 191

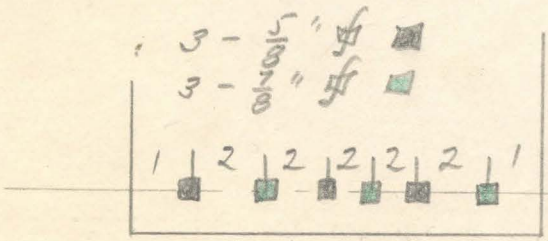
Max. Unit Shear = 96 #/0"
Stirrups No = 9
1' = 70"
Spacing = $2\frac{3}{4}$ - 8 - $13\frac{1}{2}$ - $19\frac{3}{4}$ - $26\frac{1}{2}$ - 34 - $41\frac{3}{4}$ - 51 - $62\frac{1}{2}$

Total Unif. Load = 35820 = 20 x 1791
Cono. Loads =
Total Load =
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = $\frac{1}{10}$		M Coef.	$\frac{1}{10}$	$\frac{1}{20}$
M = 860,000	"#	M at ℄ of support	860,000 "#	430,000 "#
M/bd2 = M/60x(18)² = 44.3		M at face support	"#	"#
b = 60	"	M/bd²	M/12x(18)² = 221.5	M/12x(18)² = 110.8
d = 18	"	Steel top	3.415 sq."	sq."
t/d = 4.75/18 = .2635		p	.0158	
fo = 375	#/sq."	p'	.0113	
jd = .913 x 18 = 16.45	"	M/bd² allowable	133.5	133.5
As = .0031 x 60 x 18 = 3.35	sq."	f'steel	8550 #/sq."	#/sq."
Steel = 3-$\frac{5}{8}$" + 3-$\frac{7}{8}$" = 3.47	sq."	Length to develop	16 "	"
		Bond Stress	120 #/sq."	#/sq."
p = .0031		Steel bottom	2.44 sq."	sq."

Bend 3 - $\frac{7}{8}$" sq over right support



Steel at Center

MARK 6-1

Computed H.V.G. Date 5/27/24
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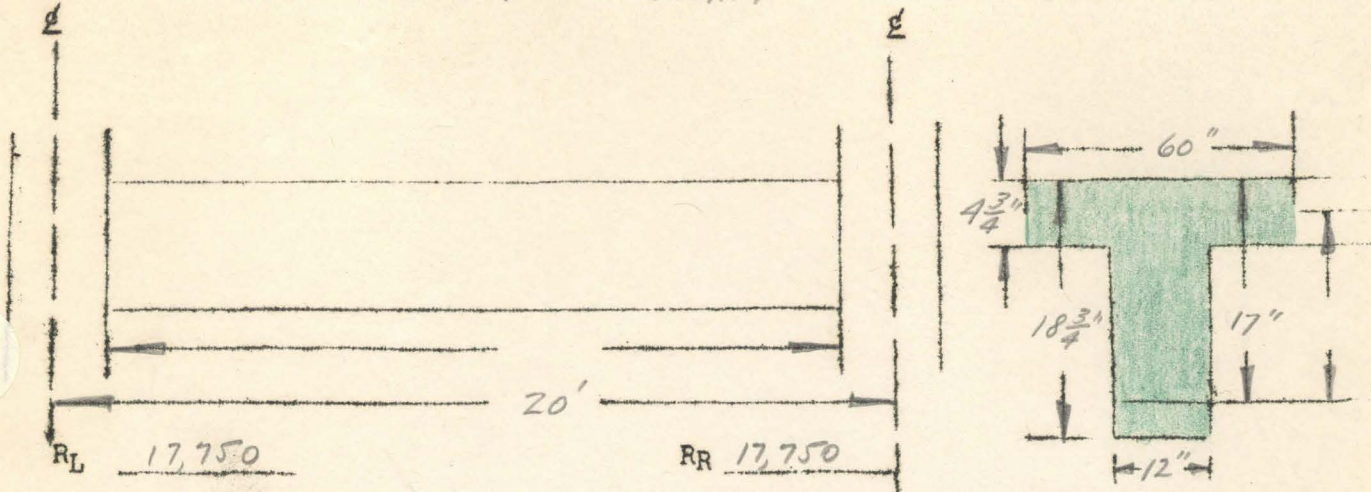
MIMEO #1

INTERMEDIATE FLOOR BEAM



Uniform Load per Foot
Slab 10x160 = 1600
Stem 14x12x 1.04 = 175

Max. Unit Shear = 100 #/0"
Stirrups No = 9
l' = 72"
Spacing = 2¾ - 8 - 14 - 20½ - 27½ - 35 - 43 - 52¾ - 64½

Total Unif.Load = 35,500 = 20 x 1775
Cono. Loads =
Total Load =
Equiv. Load =

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef.=	1/12	M Coef.	1/12	1/10
M =	710,000 "#	M at ℄ of support	710,000 "#	852,000 "#
M/bd2 = M/60x(17)² =	41	M at face support	"#	"#
b =	60 "	M/bd²	M/12x(17)² = 205	M/12x(17)² = 246
d =	17 "	Steel top	3.0 sq."	3.57 sq."
t/d =	4.75/17 = .279	p	.0147	.0175
fc =	355 #/sq."	p'	.0093	.0146
jd =	.916x17 = 15.59 "	M/bd² allowable	133.5	133.5
As =	.00285x60x17 = 2.91 sq."	f'steel	8550 #/sq."	8550 #/sq."
Steel =	6-¾"ℊ = 3.375 sq."	Length to develop	14 "	14
		Bond Stress	120 #/sq."	120 #/sq."
p =	.00285	Steel bottom	1.898 sq."	2.98 sq."

Steel spacing same as shown on MIMEO #1
Bend 4-¾"ℊ over left support
" 3-¾"ℊ " right "

MARK 6-2

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MIMEO # 2

MIMEO #3 (cont.) 6-3

Total $M_{\frac{1}{8}} = 5,122,200$ "#
$M_{\frac{1}{10}} = 4,097,360$ "#
$M_{\frac{1}{20}} = 2,048,680$ "#

$$N_3 = \frac{20 \times 30 \times 12 \times ([83]^2 - [40]^2)}{6\chi \cdot 281 \times 16000 \times 83} = 17 \text{ stirrups}$$

MIMEO #4 6-4

$M_{\frac{1}{10}} = \frac{1}{10}\ 1991 \times (20)^2 \times 12 = 957,000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 478,500$ "#

MIMEO #5 6-5

$M_{\frac{1}{12}} = \frac{1}{12} \times 1991 \times (20)^2 \times 12 = 796,400$ "#

MIMEO #6 6-6

Conc. Moment ⤻
$M_{\frac{1}{8}} = 17,910 \times 10 \times 12 = 2,149,200$ "#
$M_{\frac{1}{10}} = \frac{8}{10} \times 2,149,200 = 1,719,360$ "#
$M_{\frac{1}{20}} = \frac{8}{20} \times 2,149,200 = 859,680$ "#

Unif Moment ⤻
$M_{\frac{1}{8}} = \frac{1}{8} \times 2471 \times (30)^2 \times 12 = 3,336,000$ "#
$M_{\frac{1}{10}} = \frac{1}{10}$ do $= 2,670,000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 1,335,000$ "#

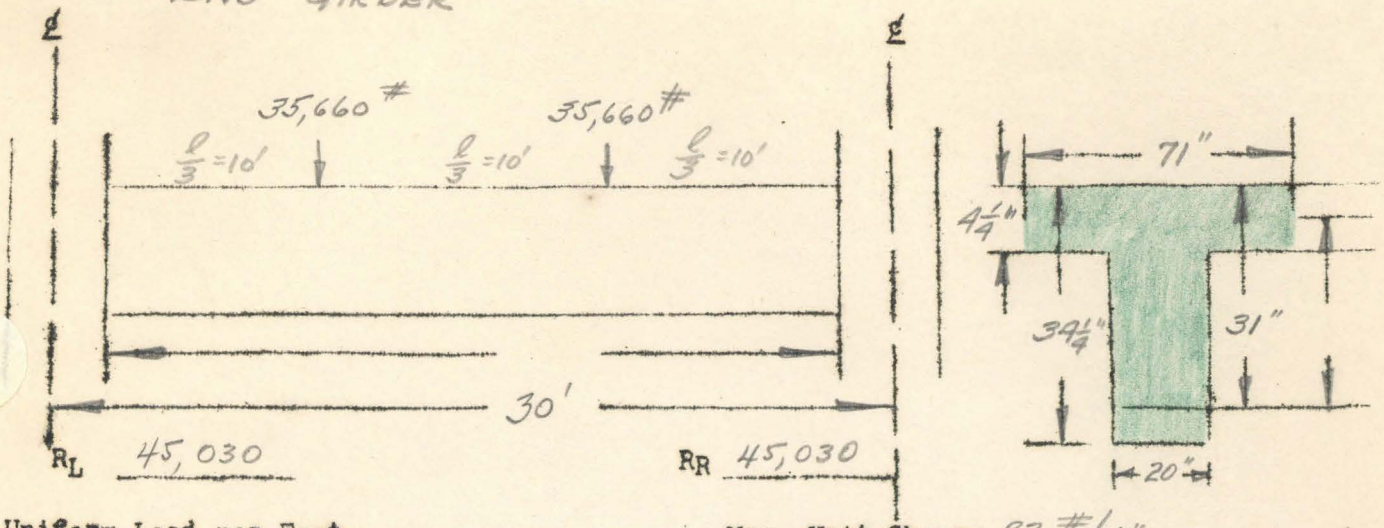
Total Moment ⤻
$M_{\frac{1}{8}} = 5,485,200$ "#
$M_{\frac{1}{10}} = 4,389,360$ "#
$M_{\frac{1}{20}} = 2,194,680$ "#

Unif Moment ⤻
$M_{\frac{1}{8}} = \frac{1}{8} \times 2584 \times (30)^2 \times 12 = 3,490,000$ "#
$M_{\frac{1}{10}} = \frac{1}{10}$ do $= 2,790,000$ "#
$M_{\frac{1}{20}} = \frac{1}{20}$ do $= 1,395,000$ "#

Total Moment ⤻
$M_{\frac{1}{8}} = 5,639,200$ "#
$M_{\frac{1}{10}} = 4,509,360$ "#
$M_{\frac{1}{20}} = 2,254,680$ "#

$$N_5 = \frac{20 \times 30 \times 12 \times [(97)^2 - (40)^2]}{6 \times .281 \times 16000 \times 97} = 22 \text{ stirrups}$$

END GIRDER



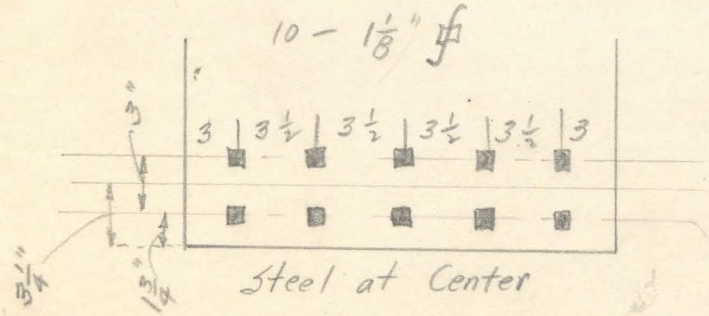
Uniform Load per Foot
Slab =
Stem 30x20x1.04 = 624

Total Unif.Load = 18,740 = 30 x 624
Conc. Loads = 71,320
Total Load = 90,060
Equiv. Load =

Max. Unit Shear = 83.#/sq."
Stirrups No = 17
l' = 93"
Spacing = 2-4-6-8-10-12-14-17-21-25-30-35-41-47-54-63-75

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/8	1/20
M = 4,097,360	"#	M at ℄ of support	5,122,200 "#	2,048,680 "#
M/bd2 = M/71x(31)² = 60		M at face support	"#	"#
b = 71	"	M/bd²	M/20x(31)² = 266	M/20x(31)² = 106.5
d = 31	"	Steel top	11.8 sq."	sq."
t/d = 4.25/31 = .137		p	.019	
f_o = 580	#/sq."	p'	.0172	
jd = .937x31 = 29.1	"	M/bd² allowable	133.5	133.5
As = .004 x 71 x 31 = 8.81	sq."	f' steel	8550 #/sq."	#/sq."
Steel = 10-1 1/8" ℄ = 12.656	sq."	Length to develop	20 "	"
		Bond Stress	120 #/sq."	#/sq."
p = .004		Steel bottom	10.68 sq."	sq."



Steel at Center

MARK 6-3

Computed H.V.G. Date 6/5/24
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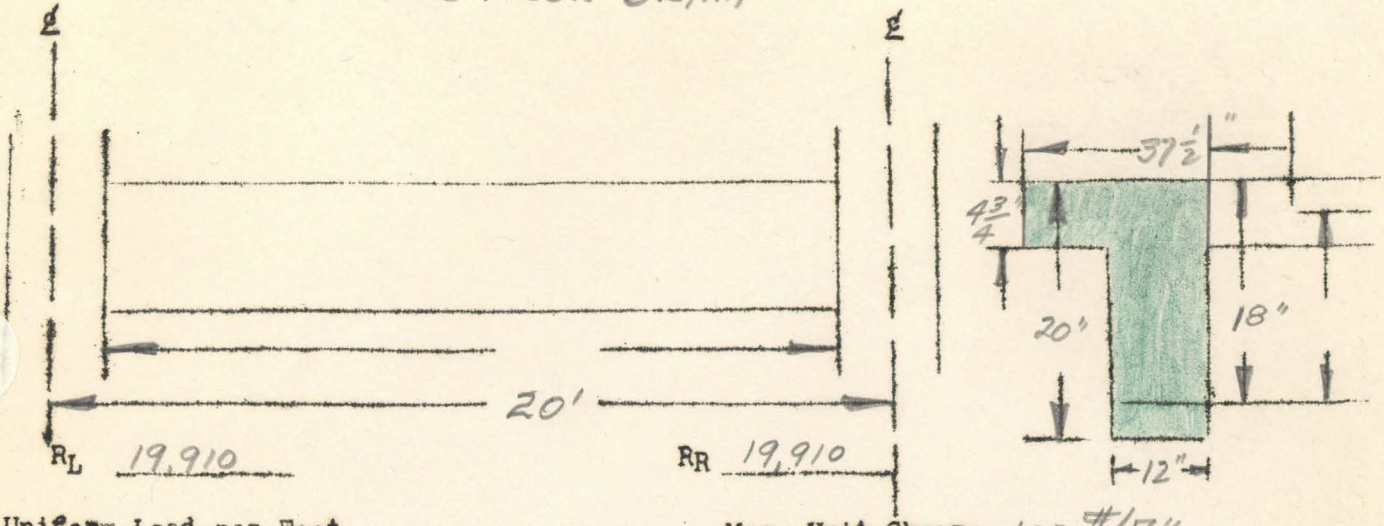
MIMEO #3

END SPANDREL FLOOR BEAM



Uniform Load per Foot
Slab =
Stem 15.25 x 12 x 1.04 = 191
Brick Wall = 120 x 15 = 1800

Total Unif. Load = 39,820 = 20 x 1991
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear = 107 #/□"
Stirrups No = 10
1' = 79"
Spacing = 3-7-12¾-18½-25½-32¾-40½-49-59-71¼

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. = 1/10		M Coef.	1/10	1/20
M = 957,000	"#	M at ℄ of support	957,000 "#	478,500 "#
M/bd2 = M/(37.5)(18)² = 78.9		M at face support	"#	"#
b = 37.5	"	M/bd²	M/12x(18)² = 246	M/12x(18)² = 123
d = 18	"	Steel top	3.78 sq."	sq."
t/d = 4.75/18 = .264		p	.0175	
fo = 550	#/sq."	p'	.0146	
jd = .8995 x 18 = 16.01	"	M/bd² allowable	133.5	133.5
As = .0048 x 37.5 x 18 = 3.24 sq."		f'steel	8550 #/sq."	#/sq."
Steel = 10-⅝"ϕ = 3.906 sq."		Length to develop	14 "	
		Bond Stress	120 #/sq."	#/sq."
p = .0048		Steel bottom	3.155 sq."	sq."

For steel arrangement see MIMEO #5, System #3

MARK 6-4

Computed H.V.G. Date 6/5/24
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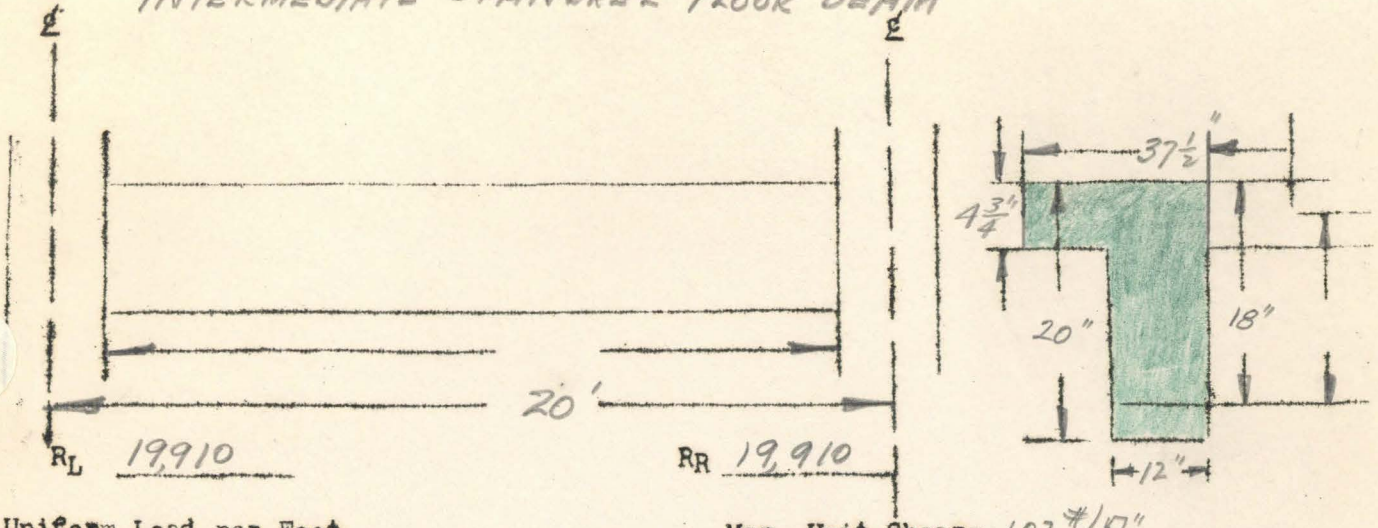
MIMEO # 4

INTERMEDIATE SPANDREL FLOOR BEAM



Uniform Load per Foot
Slab =
Stem 15.25 x 12 x 1.04 = 191
Brick Wall 1800

Total Unif. Load = 39,820 = 20 x 1991
Conc. Loads =
Total Load =
Equiv. Load =

Max. Unit Shear = 107 #/D"
Stirrups No = 10
l' = 79"
Spacing = 3-7-12¾-18½-25½-32¾-40½-49-59-71¼

$\frac{d'}{d} = \frac{1}{10}$

CENTER	SUPPORT	Right	Left
M Coef. = 1/12	M Coef.	1/12	1/10
M = 796,400 "#	M at ℄ of support	796,400 "#	957,000 "#
M/bd2 = M/37.5 x (18)² = 65	M at face support	"#	"#
b = 37.5 "	M/bd²	M/12x(18)² = 205	M/12x(18)² = 246
d = 18 "	Steel top	3.18 sq."	3.78 sq."
t/d = 4.75/18 = .264	p	.0147	.0175
fo = 475 #/sq."	p'	.0092	.0146
jd = .901 x 18 = 16.2 "	M/bd² allowable	133.5	133.5
As = .0045 x 37.5 x 18 = 3.04 sq."	f' steel	8550 #/sq."	8550 #/sq."
Steel = 6-¾" sq = 3.375 sq."	Length to develop	14 "	14 "
	Bond Stress	120 #/sq."	120 #/sq."
p = .0045	Steel bottom	1.99 sq."	3.155 sq."

For steel arrangement see MIMEO #6, System #3

MARK 6-5

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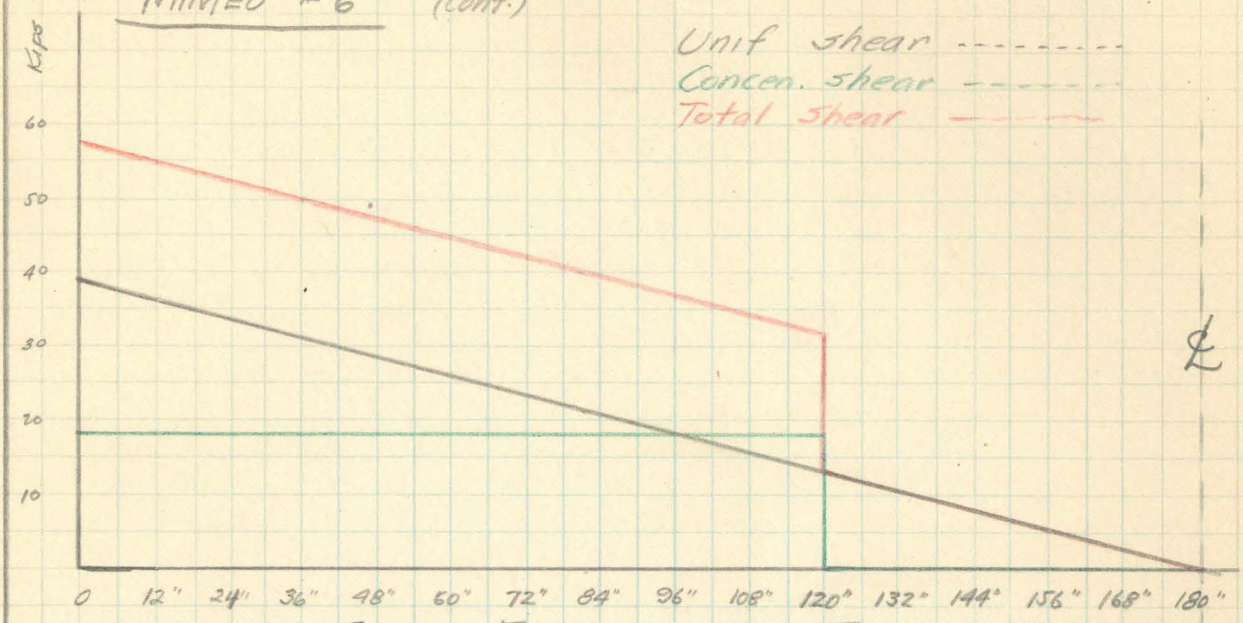
MIMEO #5

MIMEO #6 (cont.)



SHEAR DIAGRAM FOR STIRRUP SPACING

$$S = \frac{\frac{3}{2} \times .281 \times 16000 \times .874 \times 33}{V} = \frac{194,700}{V}$$

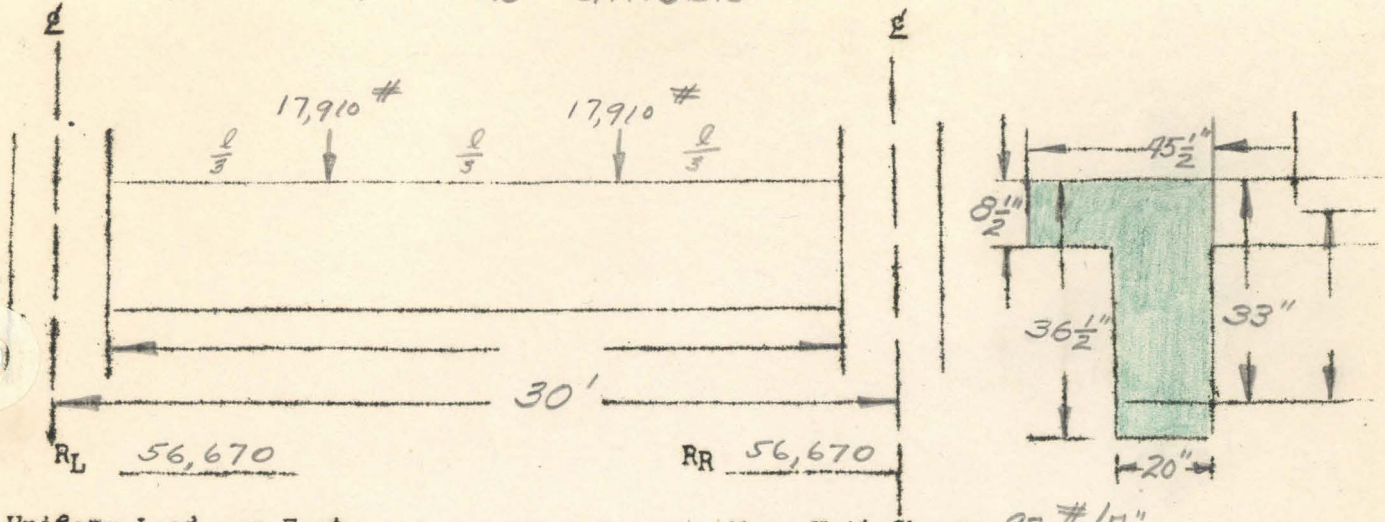
Spacing taken from table Pg 288, Hool and Johnson Concrete Engineers Handbook. Table computed from above formula. Shear taken from above diagram. 3/8" □ U-shaped stirrups.

$3\frac{3}{4} - 7\frac{1}{2} - 11\frac{1}{4} - 15 - 18\frac{3}{4} - 22\frac{1}{2} - 26\frac{1}{4} - 30 - 34 - 38 -$

$- 42\frac{1}{4} - 46\frac{1}{2} - 50\frac{3}{4} - 55\frac{1}{4} - 59\frac{3}{4} - 64\frac{1}{2} - 69\frac{1}{2} -$

$- 74\frac{3}{4} - 80\frac{1}{4} - 86 - 92 - 98\frac{1}{2}$

END SPANDREL GIRDER



Uniform Load per Foot

Slab	4.25 x 45.5 x 1.04	=	201
Stem	28 x 20 x 1.04	=	583
	Brick Wall		1800

Total Unif. Load = 77520 = 30 x 2584

Conc. Loads = 35820

Total Load = 113,340

Equiv. Load =

Max. Unit Shear = 97 #/□"

Stirrups No = 22

l' = 106

Spacing = 3¾ - 7½ - 11¼ - 15 - 18¾ - 22½ - 26¼ - 30 - 34 - 38 - 42¼ - 46½ - 50¾ - 54¼ - 59¾ - 64½ - 69½ - 74¾ - 80¼ - 86 - 92 - 98½

$\frac{d'}{d} = \frac{1}{10}$

CENTER		SUPPORT	Right	Left
M Coef. =	1/10	M Coef.	1/8	1/20
M =	4,509,360 "#	M at ℄ of support	5,639,200 "#	2,254,680 "#
M/bd2 = M/(45.5)(33)² =	91.1	M at face support	"#	"#
b =	45.5 "	M/bd²	M/20x(33)² = 259	M/20x(33)² = 103.7
d =	33 "	Steel top	12.22 sq."	sq."
t/d = 8.5/33 =	.2575	p	.0185	
fo =	620 #/sq."	p'	.0163	
jd = .895 x 33 =	29.5 "	M/bd² allowable	133.5	133.5
As = .0064 x 45.5 x 33 =	9.61 sq."	f'steel	8550 #/sq."	#/sq."
Steel = 10-1⅛" sq. =	12.66 sq."	Length to develop	20 "	
		Bond Stress	120 #/sq."	#/sq."
p =	.0064	Steel bottom	10.78 sq."	sq."

MARK 6-6

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MIMEO #6

Exterior Column – 20' side

5th to 6th

Load

Slab = 158 x 30 x 10	=	47,400
F.Beam = 183 x 20	=	3,660
Girder = 624 x 15	=	9,360
Spandrel = 1991 x 20	=	39,820
		100,240
Increase 20% for ecc.		20,048
Assume wt. of col.		5,250
		125,538 #

SQUARE COLUMN

Dia. of col. = 18"
" " core = 14"
Use 6 – 1" ⌀
" ¼" □ lateral ties spaced 12"
Allowable load = 126,000 #
Wt. of col. = 338 x 15 = 5070 # ∴ O.K.

4th to 5th.

Load

Same as before	=	100,240
Increase 20%	=	20,048
Load from col. above	=	125,538
Assume wt. of col.	=	6,250
		252,076 #

ROUND COLUMN

Dia. of col. = 22"
" " core = 18"
Use 10 – ⅞" ⌀
Spiral – gage = #3/0 p = 1.020
pitch = 2¼"
Allowable load = 253,200 #
Wt. of col. = 396 x 15 = 5940 # ∴ O.K.

3rd to 4th

Load

Same as before	=	100,240
Increase 20%	=	20,048
Load from col. above	=	252,076
Assume wt. of col.	=	8,500
		380,864 #

ROUND COLUMN

Dia. of col. = 26"
" " core = 22"
Use 12 – 1" ⌀
Spiral – gage = #4/0 p = 1.045
pitch = 2⅛"
Allowable load = 383,700 #
Wt. of col. = 553 x 15 = 8295 # ∴ O.K.

2nd to 3rd

Load

Same as before	=	100,240
Increase 20%	=	20,048
Load from col. above	=	380,864
Assume wt. of col.	=	10,500
		511,652 #

Wt. of col. = 688 x 15 = 10,320 # ∴ O.K.

ROUND COLUMN

Dia. of col. = 29"
" " core = 25"
Use 14 – 1⅛" ⌀
Spiral – gage = #6/0 p = 1.027
pitch = 2¼"
Allowable load = 517,200 #

1st to 2nd

Load

Same as before	=	100,240
Increase 20%	=	20,048
Load from col. above	=	511,652
Assume wt. of col.	=	12,750
		644,690 #

ROUND COLUMN

Dia. of col. = 32"
" " core = 28"
Use 22 – 1" ⌀
Spiral – gage = #5/0 p = 1.040
pitch = 2"
Allowable load = 646,700 #
Wt. of col. = 838 x 15 = 12,570 # ∴ O.K.

Exterior Column — 30' side

5th to 6th

Load

Slab = 153 x 10 x 30 =	45,900
F. Beam = 191 x 10 x 3 =	5,730
Spandrel = 2584 x 30 =	77,520
	129,150
Increase 20% for acc.	25,930
Assume wt. of col.	6,500
	161,580 #

SQUARE COLUMN

Dia. of col. = 20"
" " core = 16"
Use 6 - 1⅛" sq
" ¼" □ lateral ties spaced 12"
Allowable load = 163,000 #
Wt. of col. = 417 x 15 = 6255 # ∴ O.K.

4th to 5th

Load

Same as before =	129,150
Increase 20% =	25,930
Load from col. above =	161,580
Assume wt. of col. =	7,250
	323,910 #

ROUND COLUMN

Dia. of col. = 24"
" " core = 20"
Use 14 - ⅞" sq
Spiral — gage = #3/0 p = 1.032
pitch = 2"
Allowable load = 324,900 #
Wt. of col. = 471 x 15 = 7065 # ∴ O.K.

3rd to 4th

Load

Same as before =	129,150
Increase 20% =	25,930
Load from col. above =	323,910
Assume wt. of col. =	9,750
	488,740 #

ROUND COLUMN

Dia. of col. = 28"
" " core = 24"
Use 14 - 1⅛" sq
Spiral — gage = #4/0 p = 1.013
pitch = 2"
Allowable load = 490,300 #
Wt. of col. = 641 x 15 = 9615 # ∴ O.K.

2nd to 3rd

Load

Same as before =	129,150
Increase 20% =	25,930
Load from col. above =	488,740
Assume wt. of col. =	13,500
	657,320 #

ROUND COLUMN

Dia. of col. = 33"
" " core = 29"
Use 20 - 1" sq
Spiral — gage = #6/0 p = 1.027
pitch = 2¼"
Allowable load = 658,400 #
Wt. of col. = 891 x 15 = 13,365 # ∴ O.K.

1st to 2nd

Load

Same as before =	129,150
Increase 20% =	25,930
Load from col. above =	657,320
Assume wt. of col. =	16,000
	828,400 #

ROUND COLUMN

Dia. of col. = 36"
" " core = 32"
Use 22 - 1⅛" sq
Spiral — gage = #6/0 p = 1.047
pitch = 2"
Allowable load = 835,800 #
Wt. of col. = 1060 x 15 = 15,900 # ∴ O.K.

Interior Column

5th to 6th

Load

Slab = 153 x 20 x 30 = 91,800
F. Beam = 183 x 20 x 3 = 10,980
Girder = 624 x 30 = 18,720
121,500
Assume wt. of col. 5,250
126,750 #

SQUARE COLUMN

Dia. of col. = 18"
" " core = 14"
Use 8 - $\frac{7}{8}$" ⌀
" $\frac{1}{4}$" □ lateral ties spaced 12"
Allowable load = 126,800 #
Wt. of col. = 338 x 15 = 5070 # ∴ O.K.

4th to 5th

Load

Same as before = 121,500
Load from col. above = 126,750
Assume wt. of col. = 6,250
254,500 #

ROUND COLUMN

Dia. of col. = 22"
" " core = 18"
Use 14 - $\frac{3}{4}$" ⌀
Spiral – gage = #3/0 p = 1.020
pitch = $2\frac{1}{4}$"
Allowable load = 255,400 #

Wt. of col. = 396 x 15 = 5940 # ∴ O.K.

3rd to 4th

Load

Same as before = 121,500
Load from col. above = 254,500
Assume wt. of col. = 8,500
384,500 #

ROUND COLUMN

Dia. of col. = 26"
" " core = 22"
Use 16 - $\frac{7}{8}$" ⌀
Spiral – gage = #4/0 p = 1.045
pitch = $2\frac{1}{8}$"
Allowable load = 386,100 #

Wt. of col. = 553 x 15 = 8295 # ∴ O.K.

2nd to 3rd

Load

Same as before = 121,500
Load from col. above = 384,500
Assume wt of col. = 10,500
516,500 #

ROUND COLUMN

Dia. of col. = 29"
" " core = 25"
Use 14 - $1\frac{1}{8}$" ⌀
Spiral – gage = #6/0 p = 1.027
pitch = $2\frac{1}{4}$"
Allowable load = 517,200 #

Wt. of col. = 688 x 15 = 10,320 # ∴ O.K.

1st to 2nd

Load

Same as before = 121,500
Load from col. above = 516,500
Assume wt. of col. = 12,750
650,750 #

ROUND COLUMN

Dia. of col. = 32"
" " core = 28"
Use 18 - $1\frac{1}{8}$" ⌀
Spiral – gage = #5/0
pitch = 2"
p = 1.040
Allowable load = 654,400 #
Wt. of col. = 838 x 15 = 12,570 # ∴ O.K.

System 4

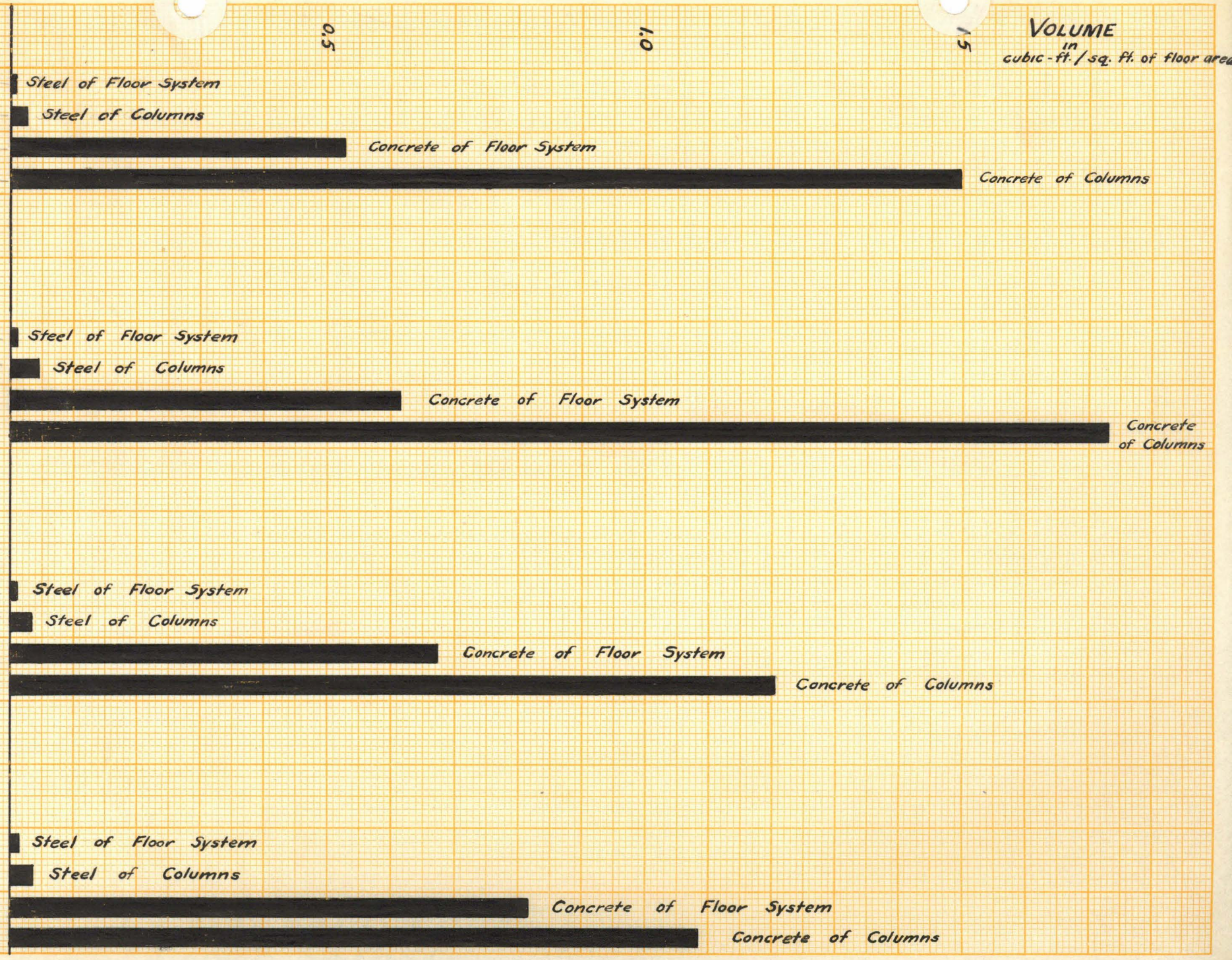
		Size	Area Sq.-ft.	Number	Length ft.	Volume Cu.-ft.	
Steel	End Slab	3/8" □	.000979	214	12.5	2.62	
	Int. Slab	3/8" □	.000979	366	15.0	5.38	
Volume	End. F. Beam	5/8" □	.00271	15	25.0	1.017	
		7/8" □	.00532	15	25.0	1.998	
	Int. F. Beam	3/4" □	.0039	30	30.0	3.51	
	End Girder	1 1/8" □	.00879	40	37.5	13.20	
	End Span. F.B.	5/8" □	.00271	20	25.0	1.355	
	Int. Span. F.B.	3/4" □	.0039	12	30.0	1.405	
	End Span. Gir.	1 1/8" □	.00879	20	37.5	6.60	
	End Ext. Col.						37.085
	5th to 6th	1 1/8" □	.00879	6	17	.898	
		1/4" □	.00043	15	5.33	.0344	
	4th to 5th	7/8" □	.00532	14	17	1.268	
		Spiral	[.01032 x 2.18 x 15]		=	.3375	
	3rd to 4th	1 1/8" □	.00879	14	17	2.09	
		Spiral	[.01013 x 3.19 x 15]		=	.478	
	2nd to 3rd	1" □	.00694	20	17	2.36	
		Spiral	[.01027 x 4.59 x 15]		=	.707	
	1st to 2nd	1 1/8" □	.00879	22	17	3.29	
		Spiral	[.01047 x 5.58 x 15]		=	.876	
	Side Ext. Col.						
	5th to 6th	1" □	.00694	36	17	4.25	
		1/4" □	.00043	90	4.67	.181	
	4th to 5th	7/8" □	.00532	60	17	5.43	
		Spiral	[.0102 x 1.77 x 15] x 6		=	1.625	
	3rd to 4th	1" □	.00694	72	17	8.50	
		Spiral	[.01045 x 2.64 x 15] x 6		=	2.48	
	2nd to 3rd	1 1/8" □	.00879	84	17	12.56	
		Spiral	[.01027 x 3.41 x 15] x 6		=	3.15	
	1st to 2nd	1" □	.00694	132	17	15.58	
		Spiral	[.0104 x 4.28 x 15] x 6		=	4.01	
	Interior Col.						
	5th to 6th	7/8" □	.00532	16	17	1.449	
		1/4" □	.00043	30	4.67	.0603	
	4th to 5th	3/4" □	.0039	28	17	1.857	
		Spiral	[.0102 x 1.77 x 15] x 2		=	.541	
	3rd to 4th	7/8" □	.00532	32	17	2.895	
		Spiral	[.01045 x 2.64 x 15] x 2		=	.828	
	2nd to 3rd	1 1/8" □	.00879	28	17	4.19	
		Spiral	[.01027 x 3.41 x 15] x 2		=	1.05	
	1st to 2nd	1 1/8" □	.00879	36	17	5.385	
		Spiral	[.0104 x 4.28 x 15] x 2		=	1.336	
							89.6962

System 4

		Cross-Sec. Area Sq.-inches	X-Sec. A. Sq-ft.	Num.	Length ft.	Volume cu. ft.	
	End Slab	4.75x480=2280	15.82	2	10	316.4	
Concrete	Int. Slab	4.25x480=2040	14.16	4	10	566.4	
	End F. Beam	15.25x12 = 183	1.27	5	20	127.0	
Volume	Int. F. Beam	14x12 = 168	1.166	5	20	116.6	
	End Girder	30x20 = 600	4.17	4	30	500.4	
	End Span. F.B.	15.25x12 = 183	1.27	2	20	50.8	
	Int. Span. F.B.	15.25x12 = 183	1.27	2	20	50.8	
	End Span. Gir.	28x20 = 560	3.89	2	30	233.4	
							1961.8

	Size		Vol. c.f./ft.	Num.	Len.	Volume	
	Col.	Core					
End Ext. Col.							
5th to 6th	20" - 16"	□	2.78	1	15	41.7	
4th to 5th	24" - 20"	○	3.14	1	15	47.1	
3rd to 4th	28" - 24"	○	4.28	1	15	64.2	
2nd to 3rd	33" - 29"	○	5.94	1	15	89.1	
1st to 2nd	36" - 32"	○	7.07	1	15	106.0	
Side Ext. Col.							
5th to 6th	18" - 14"	□	2.25	6	15	202.5	
4th to 5th	22" - 18"	○	2.64	6	15	237.6	
3rd to 4th	26" - 22"	○	3.69	6	15	332.1	
2nd to 3rd	29" - 25"	○	4.59	6	15	413.1	
1st to 2nd	32" - 28"	○	5.58	6	15	502.2	
Interior Col.							
5th to 6th	18" - 14"	□	2.25	2	15	67.5	
4th to 5th	22" - 18"	○	2.64	2	15	79.2	
3rd to 4th	26" - 22"	○	3.69	2	15	110.7	
2nd to 3rd	29" - 25"	○	4.59	2	15	137.7	
1st to 2nd	32" - 28"	○	5.58	2	15	167.4	
							2598.1

	SYSTEM 1	SYSTEM 2	SYSTEM 3	SYSTEM 4
Floor Area in square feet.	1800	1800	2400	2400
Volume of Floor Steel — cu.ft.	16.294	18.5235	26.681	37.085
" " Column " " "	49.055	82.2603	79.391	89.6962
" " Floor Concrete " "	952.52	1106.54	1615.44	1961.80
" " Column " " "	2696.10	3115.10	2892.00	2598.10
Volume of Floor Steel per □' of Floor Area	.0090522	.010290833	.011117083	.015452083
" " Col. " " " " " "	.02725277	.04570166	.033079583	.037373416
" " Floor Concrete " " " " "	.52917777	.6147444	.6731	.81741666
" " Col. " " " " " "	1.4978333	1.7306111	1.205	1.0825416



DISCUSSION OF RESULTS

This plat was constructed from data reduced to volume of steel and concrete per square foot of floor suface.

In the four systems, there is a gradual increase in the panel area. As this area increases, the steel in the floor system increases. The concrete in the floor system also increases. The steel and concrete in the columns vary differently. The first system uses less steel in the columns but uses more concrete. The second system is the most uneconomical of all in respect to the columns. System four is the most economical of all in column concrete. There is also another notable fact in that taking the total concrete in floor and column and also the total steel in floor and column, the systems would be arranged in the following manner, with the top systems using the best steel or concrete:

CONCRETE	STEEL
System 3	System 1
System 4	System 3
System 1	System 4
System 2	System 2

From this tabulation it would be concluded that System 3 was the most economical of those investigated.