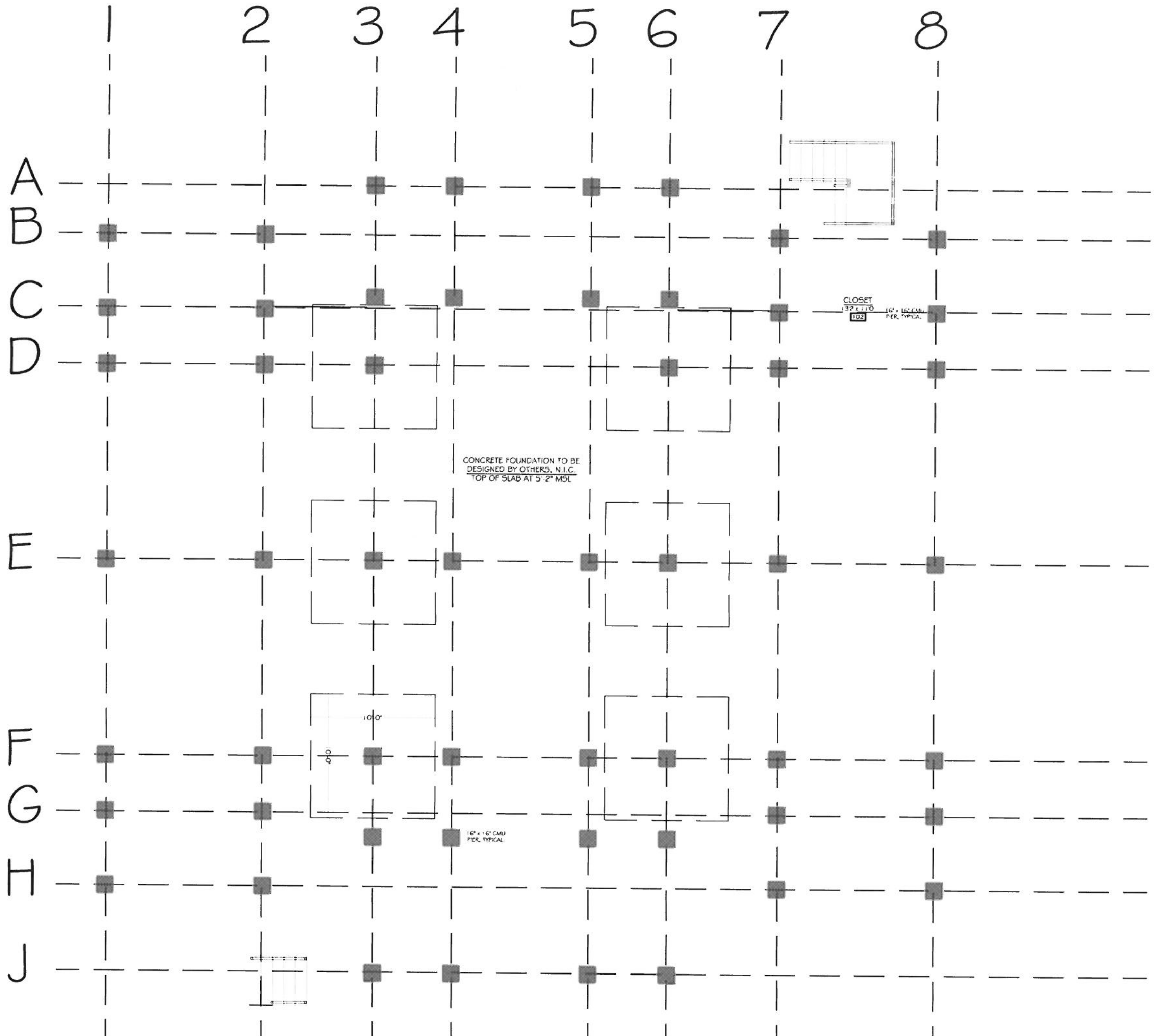
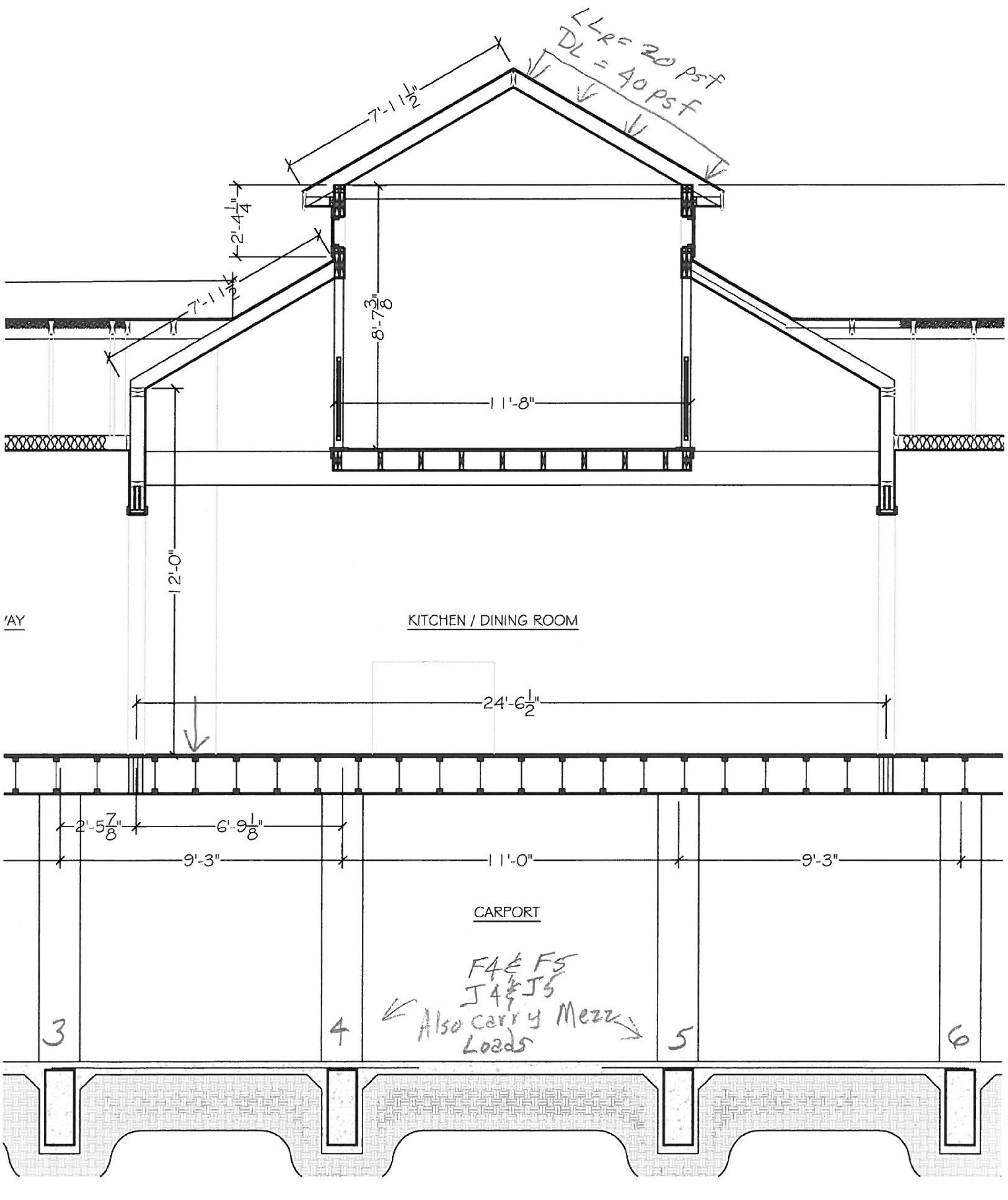


1
2
3
4
5
6
7
8
A
B
C
D
E
F
G
H
J
CLOSET
102
16" x 16" CMU PIER, TYPICAL
CONCRETE FOUNDATION TO BE DESIGNED BY OTHERS, N.I.C.
TOP OF SLAB AT 5'-2" MSL
10'-0"
10'-0"
16" x 16" CMU PIER, TYPICAL


LLR= 20 psf
DL = 40 psf
7'-11 1/2"
2'-4 1/4"
7'-11 3/4"
8'-7 3/8"
11'-8"
12'-0"
'AY
KITCHEN / DINING ROOM
24'-6 1/2"
2'-5 7/8"
6'-9 1/8"
9'-3"
11'-0"
9'-3"
CARPORT
F4 & F5
J4 & J5
Also carry Mezz Loads
3
4
5
6

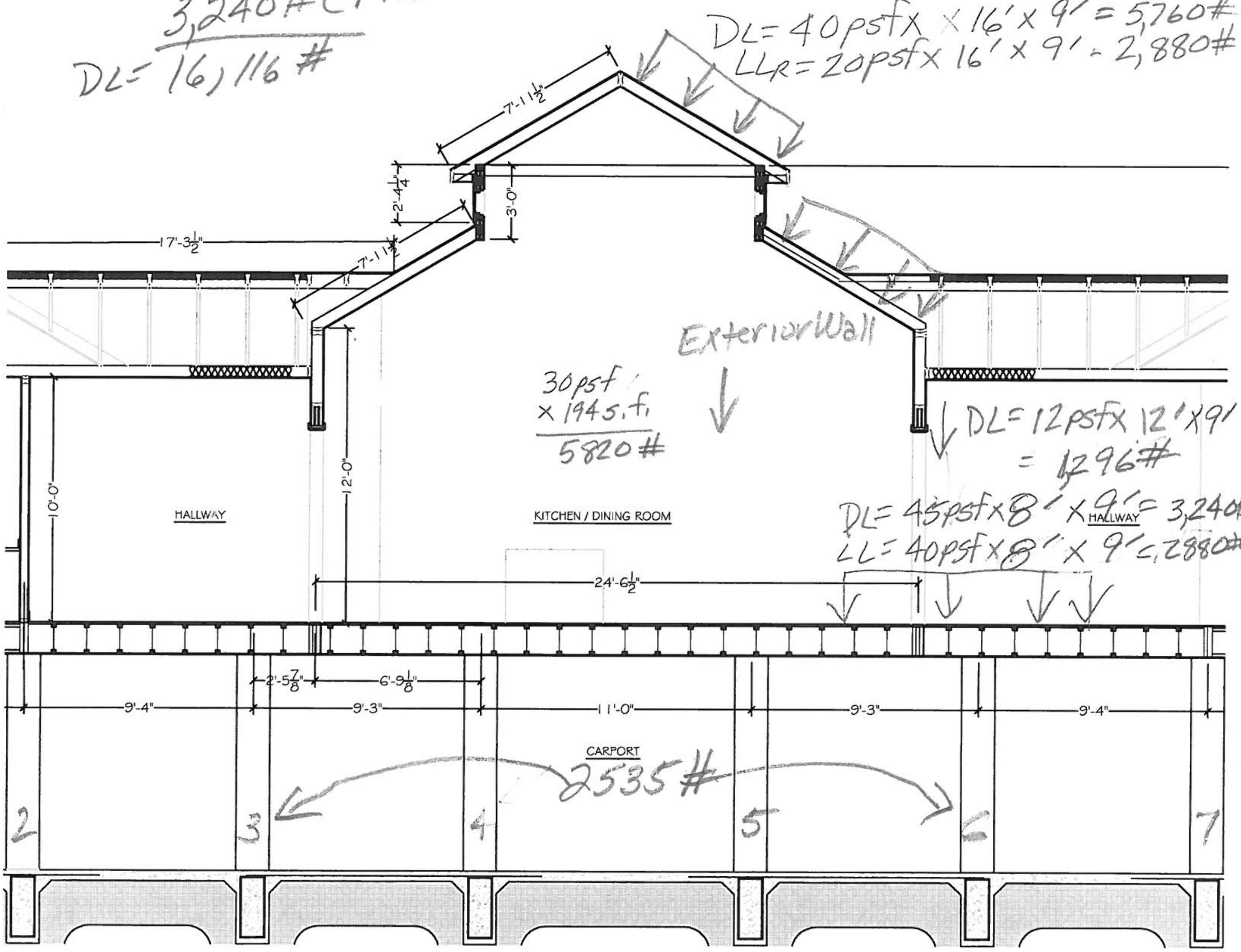
J3 & J6

LL = 2,880#

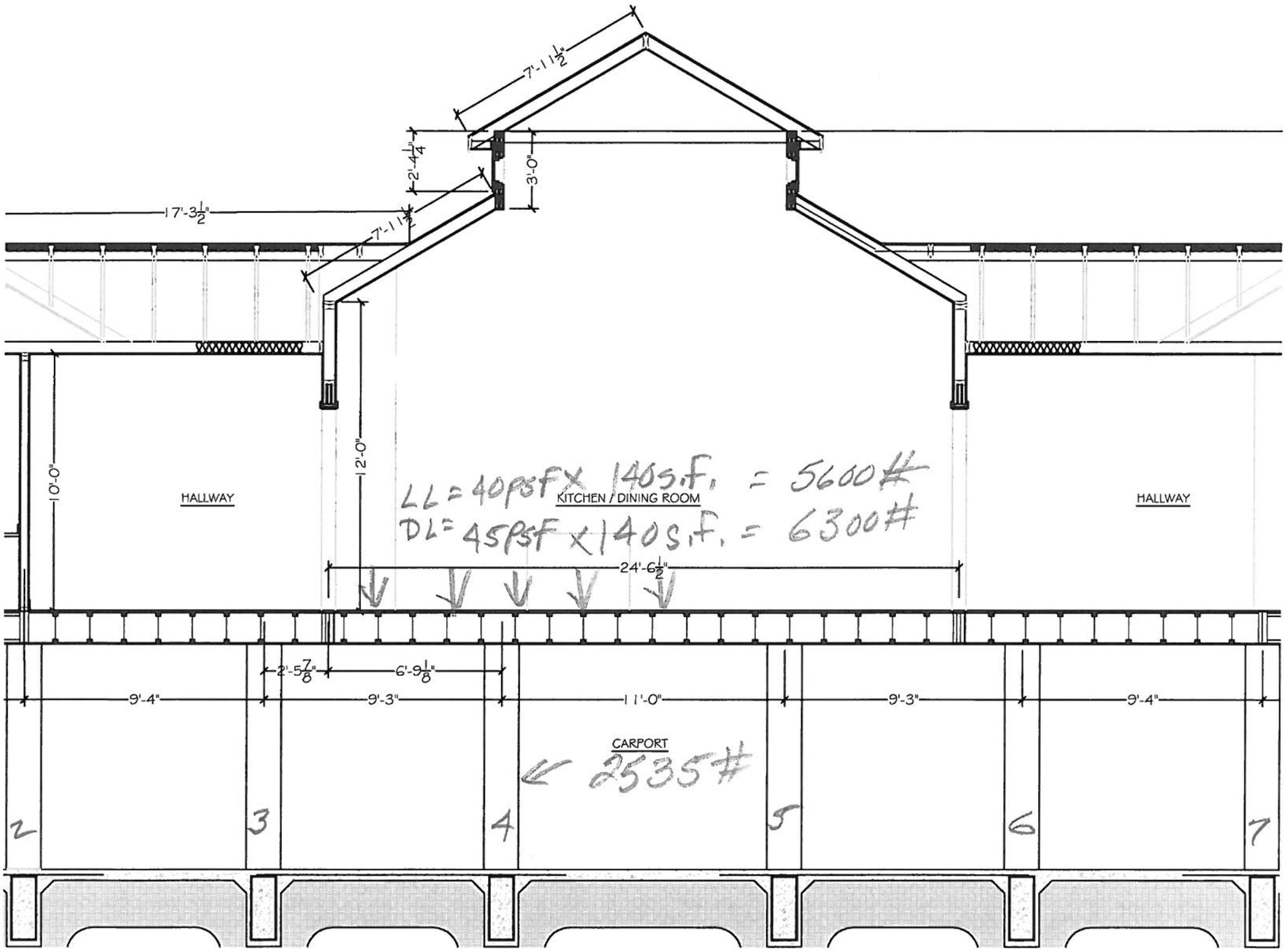
LLR = 2,880

DL = 5,760# (Roof)
5,820# (Exterior Wall)
1,296# (Interior Wall)
3,240# (Floor Load)

DL = 16,116#



G-4 & G-5



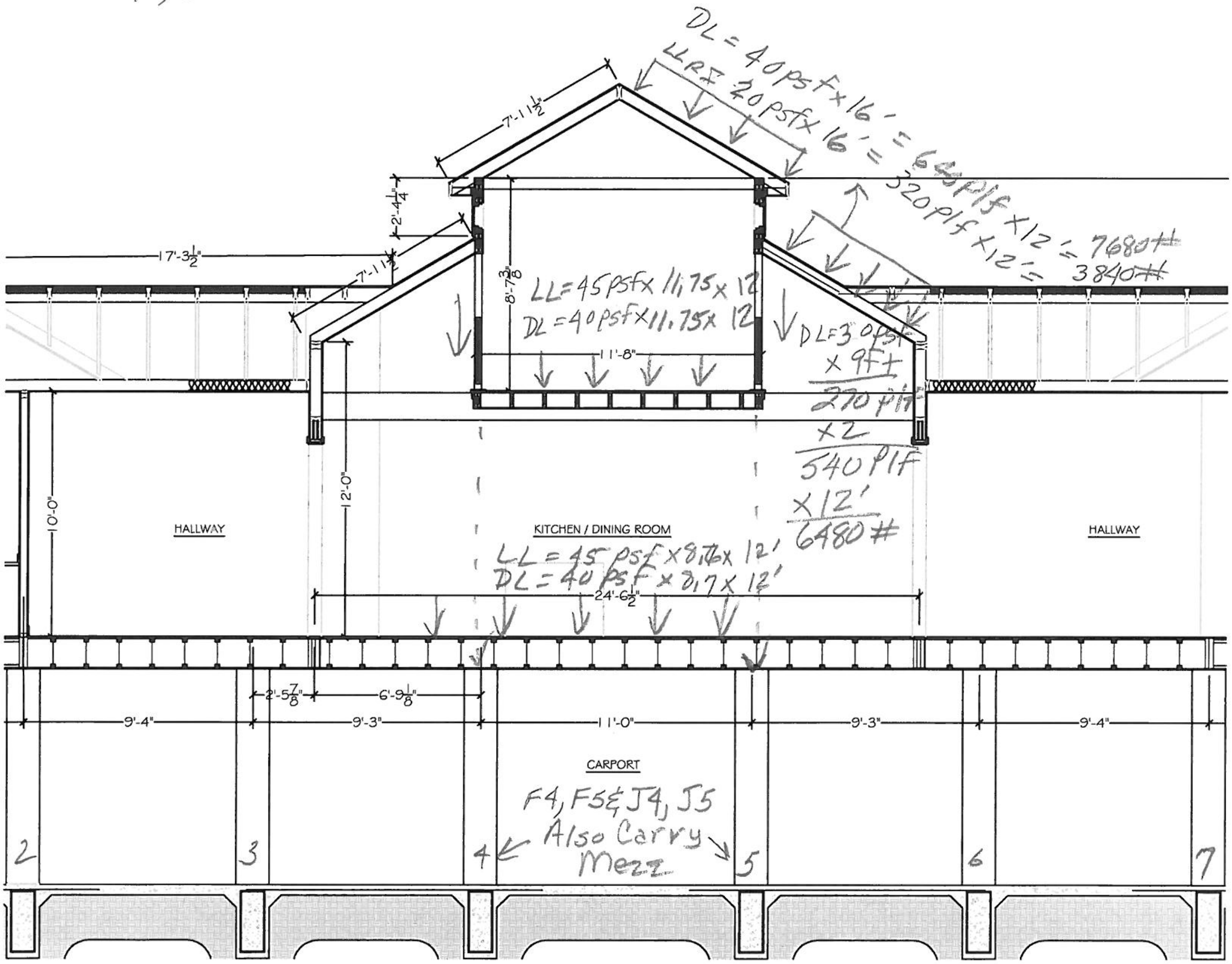
7'-11 1/2"
2'-4 1/4"
3'-0"
17'-3 1/2"
7'-11 1/2"
12'-0"
10'-0"
HALLWAY
KITCHEN / DINING ROOM
HALLWAY
LL = 40 psf x 140 s.f. = 5600#
DL = 45 psf x 140 s.f. = 6300#
24'-6 1/2"
2'-5 7/8"
6'-9 1/8"
9'-4"
9'-3"
11'-0"
9'-3"
9'-4"
CARPORT
2535#
2
3
4
5
6
7

F4, J4 & F5, J5

LL_R = 3840#

DLF 7680# (roof)
6480# (Mezz Walls)
5,640# (Mezz Floor)
4,176# (Living Rm)
23,976#

LLF 6345# (Mezz)
4698# (Living Rm)
11,643#



C-4, C-5

LL_F = 1904#

LL_R = 1504#

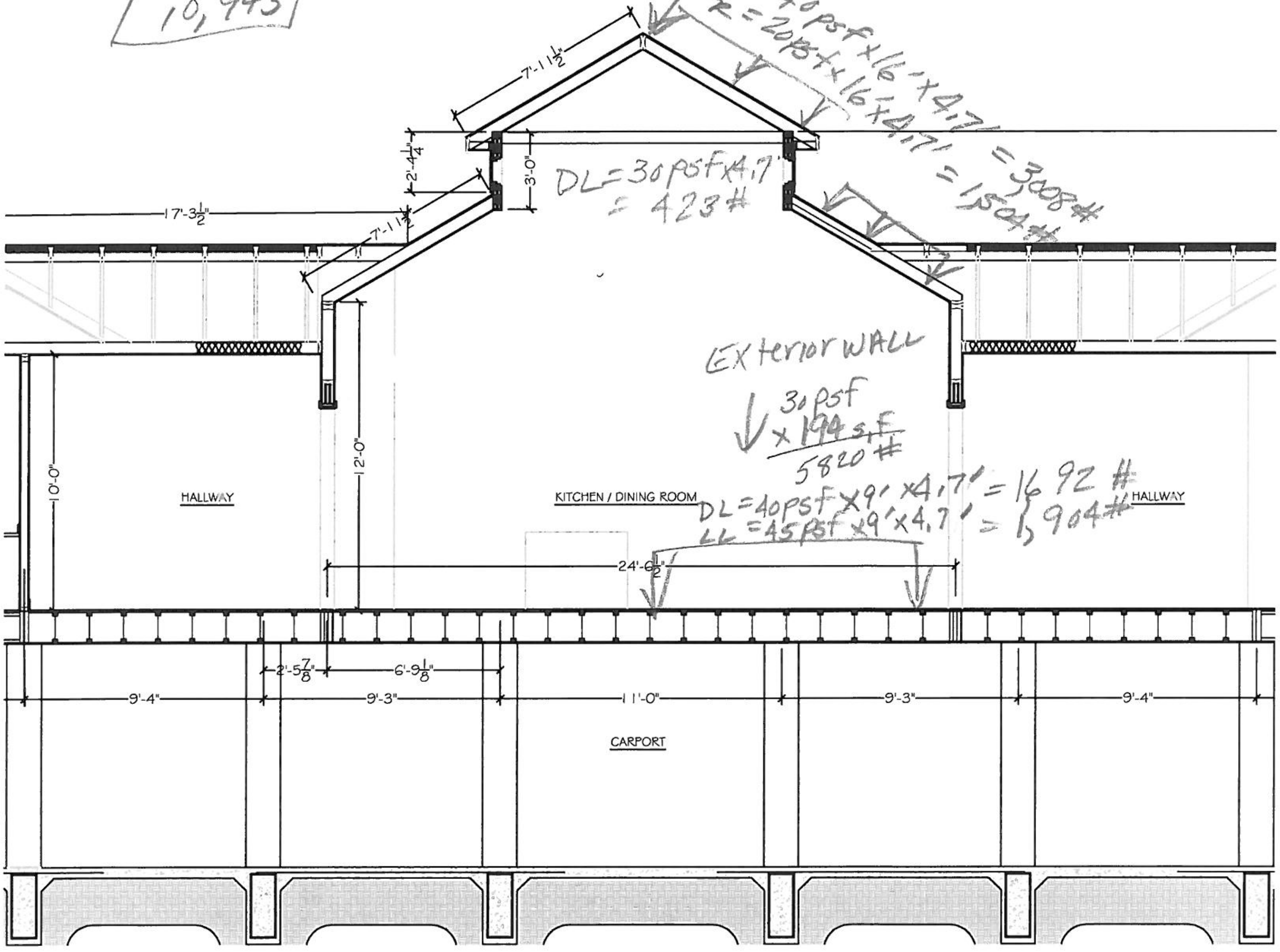
DL = 3008# (Roof)

5820# (Ext Walls)

1692# (Floor)

423#

10,943

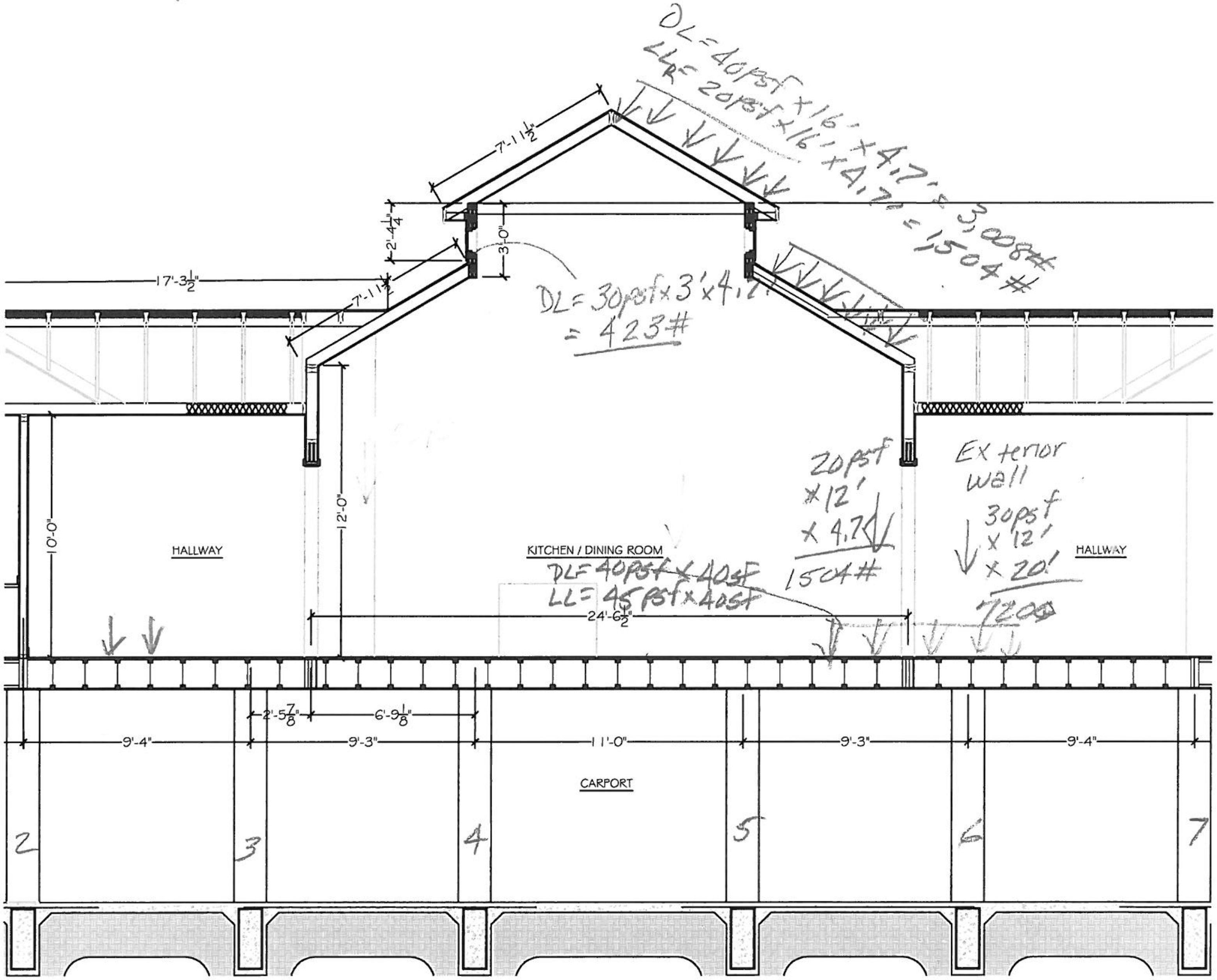


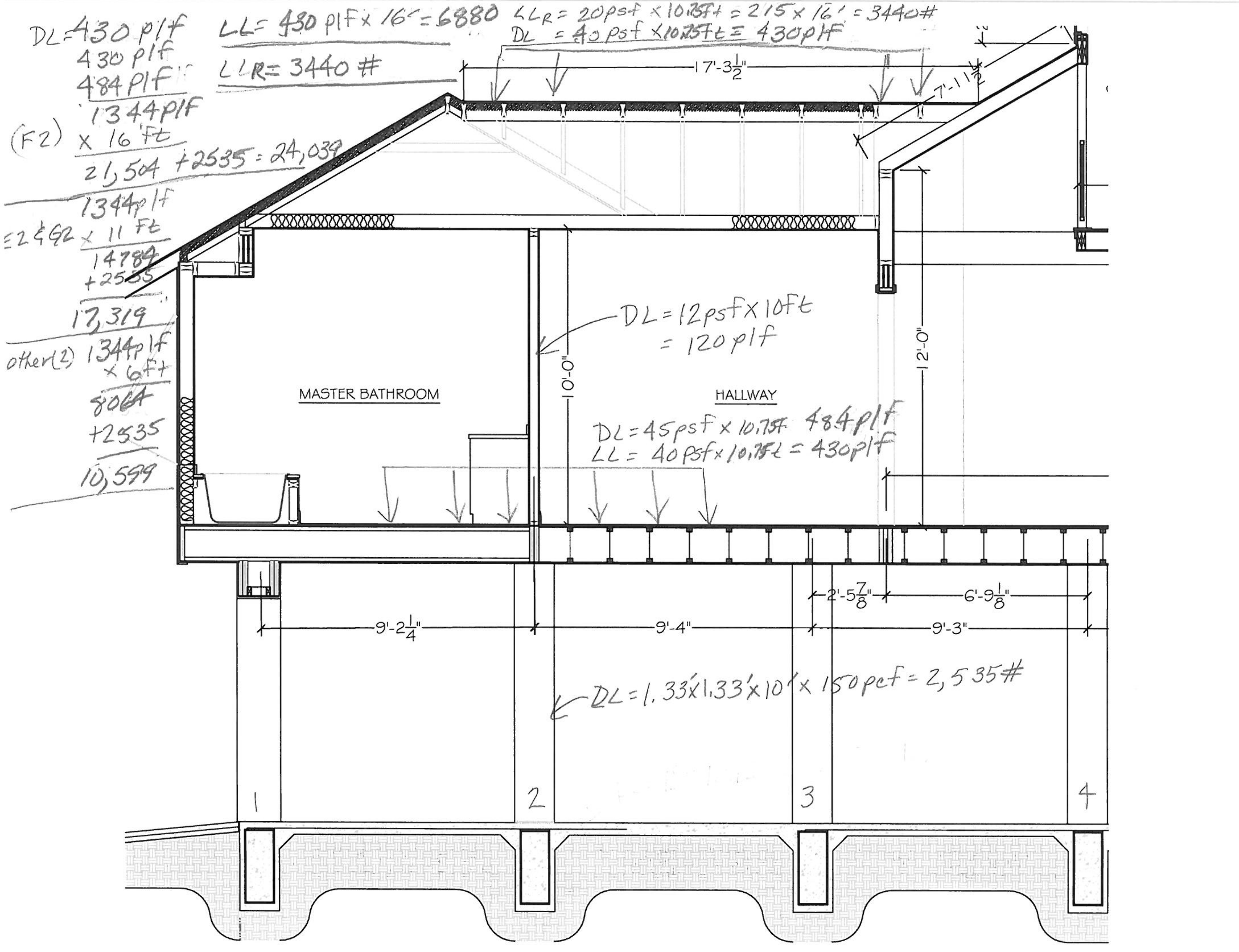
C-3 & C-6

DL = 3008# (ROOF)
+ 423# (upper Wall)
1504# (INT Wall)
7200# (EXT Wall)
1600# (Floor)

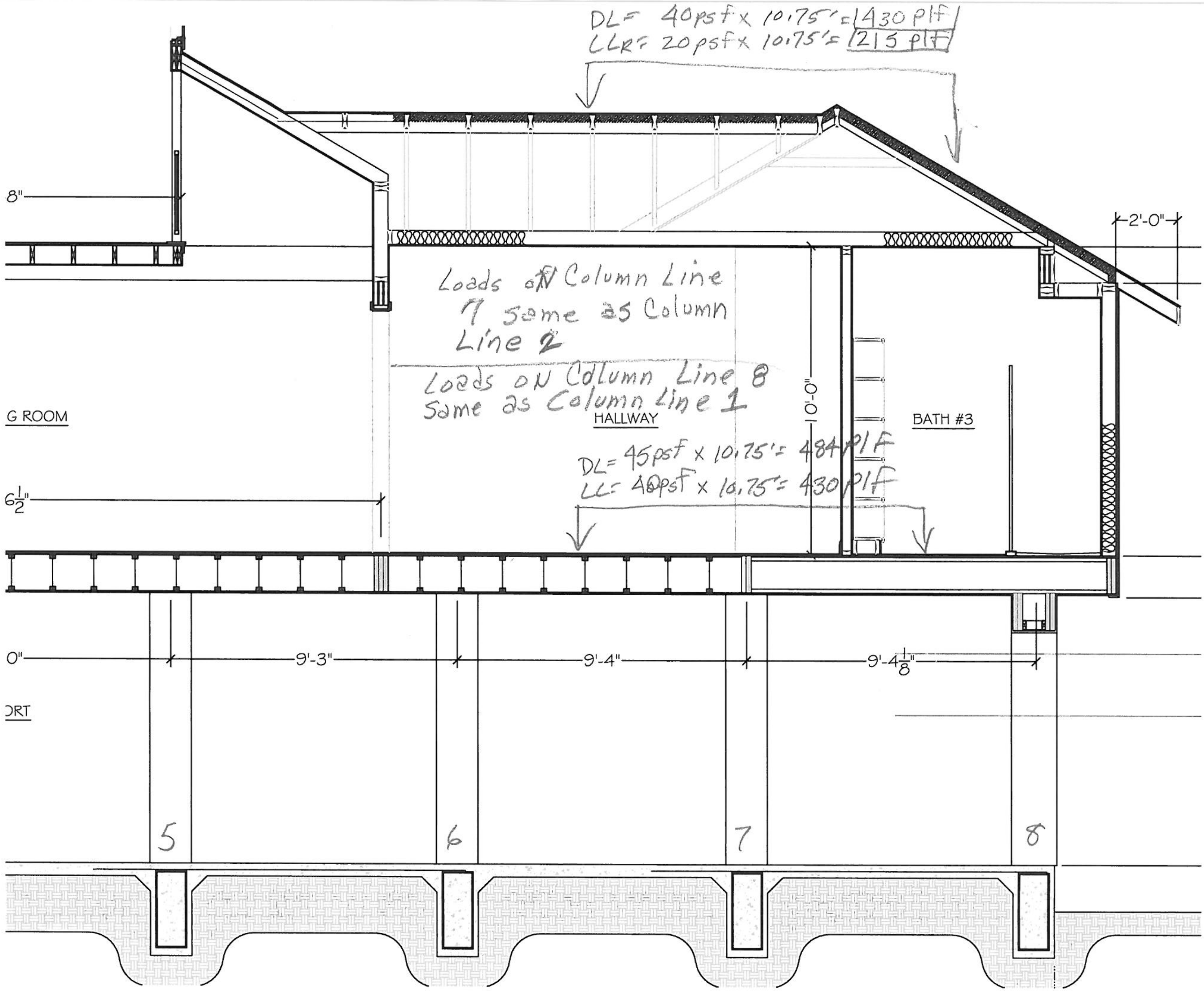
13,735

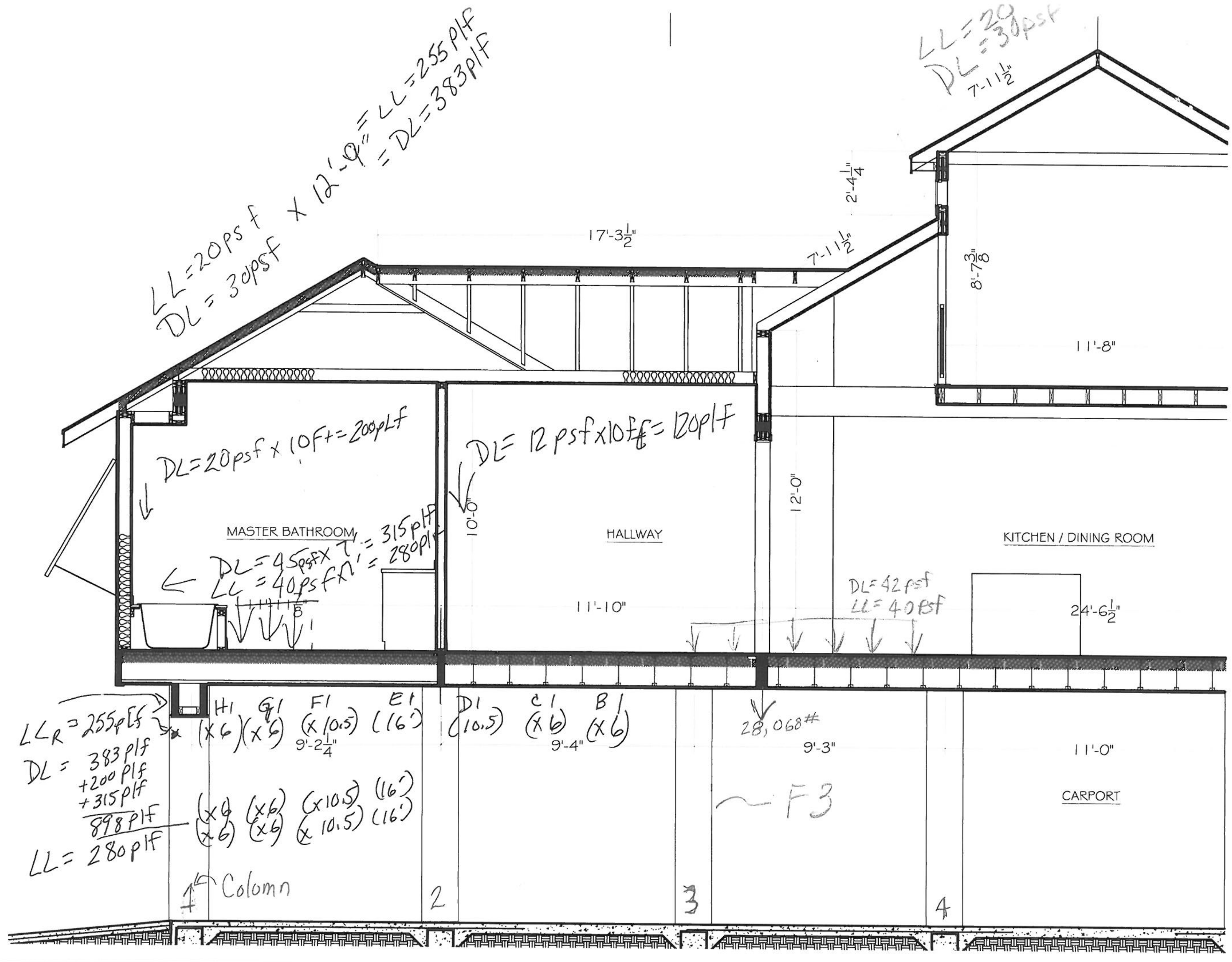
LL = 1800#
LL_R = 1504#





DL=430 plf
430 plf
484 plf
1344 plf
(F2) x 16 ft
21,504 +2535 = 24,039
1344 plf
=2&G2 x 11 ft
14784
+2535
17,319
other(2) 1344 plf
x 6 ft
8064
+2535
10,599
LL= 430 plf x 16' = 6880
LLR= 3440 #
LLR = 20psf x 10.75ft = 215 x 16' = 3440#
DL = 40 psf x 10.75ft = 430 plf
17'-3 1/2"
7'-11 1/2"
DL=12psf x 10ft
= 120 plf
10'-0"
12'-0"
MASTER BATHROOM
HALLWAY
DL=45psf x 10.75ft 484 plf
LL= 40 psf x 10.75ft = 430 plf
2'-5 7/8"
6'-9 1/8"
9'-2 1/4"
9'-4"
9'-3"
DL=1.33'x1.33'x10' x 150 pcf = 2,535#
1
2
3
4


DL= 40psf x 10.75' = 430 plf
LLR= 20psf x 10.75' = 215 plf
8"
Loads on Column Line 7 same as Column Line 2
Loads on Column Line 8 Same as Column Line 1
G ROOM
HALLWAY
BATH #3
10'-0"
2'-0"
DL= 45psf x 10.75' = 484 plf
LL= 40psf x 10.75' = 430 plf
6 1/2"
0"
9'-3"
9'-4"
9'-4 1/8"
ORT
5
6
7
8



LL=20psf x 12'-9" = LL=255plf
DL=30psf = DL=383plf
LL=20
DL=30psf
7'-11½"
2'-4¼"
17'-3½"
7'-11½"
8'-7⅜"
11'-8"
DL=20psf x 10Ft=200pLf
DL= 12psf x 10ft = 120plf
10'-0"
12'-0"
MASTER BATHROOM
HALLWAY
KITCHEN / DINING ROOM
DL=45psf x 7' = 315plf
LL=40psf x 7' = 280plf
DL=42psf
LL=40psf
11'-10"
24'-6½"
H1 G1 F1 E1 D1 C1 B1
(x6) (x6) (x10.5) (16') (10.5) (x6) (x6)
28,068#
9'-2¼"
9'-4"
9'-3"
11'-0"
LLR=255plf
DL= 383plf
+200plf
+315plf
898plf
LL= 280plf
(x6) (x6) (x10.5) (16')
(x6) (x6) (x10.5) (16')
~F3
CARPORT
Colomn
1
2
3
4

Teachout

Calculate Loads on Column F3

% is Amount Supported by F3

- Roof loads

$DL_R = 30psf \times (8'+8'+6') = 660\ plf \times 73\% = 482\ plf$

$LL_R = 20psf \times (8'+8'+6') = 440\ plf \times 73\% = 321\ plf$

- Wall Loads

$DL = 12psf \times 9ft = 108\ plf \times 73\% = 79\ plf$

$DL = 48psf \times 12ft = 576\ plf \times 73\% = 420\ plf$

- Floor Loads

Mezz DL $42\ psf \times 6ft = 252\ plf \times 73\% = 184\ plf$

Mezz LL $30\ psf \times 6ft = 180\ plf \times 73\% = 131\ plf$

2^{nd} FLR DL $42psf \times 9.25ft = 388.5\ plf \times 100\% = 284\ plf$

2^{nd} FLR LL $40psf \times 9.25ft = 370\ plf \times 100\% = 270\ plf$

Total DL = 1449 plf

" LL = 401 plf $LL_R = 321\ plf$

LRFD Calc $1.2D + 1.6L + .5L_r$

$(1.2 \times 1449) + (1.6 \times 401) + (.5 \times 321) = 2541\ plf$

The Span of Load supported by F3 $= \frac{1}{2} \times 21ft$

$= 10.5ft$

F3 point Load $= 2541\ plf \times 10.5\ ft = 26{,}681\#$

Non Point Loads around F3

1^{st} FLR $DL = (4/12 \times 150\ pcf) = 50\ psf$

1^{st} FLR $LL =$ 40 psf

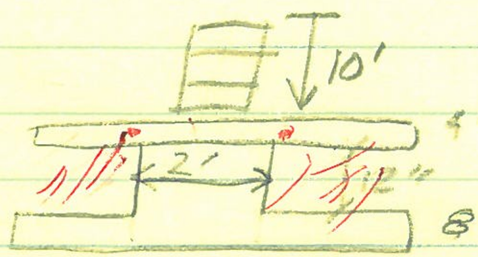
Design ReInforced Concrete footing

LL = 18,300 #
DL = 27,401 #

Concrete = 150 pcf
Steel f_y = 60,000 psi
Concrete f'_c = 3,000 psi
$q_{allowable}$ = 1,800 psf

1) Assume Sq footing thickness = 8"
7.7.3.1 ACI states a minimum soil cover over footing = 3"

2) Use #4 bars in footing



3) Estimate Size of footing (width)
5.5' x 5.5'
Weight of Stem 11' x 1.3' x 1.3' X 150 Pcf = 2788 #
Weight of footing .67 X 4.5 x 4.5 x 150 pcf = 2035 #
Weight of Soil 1' X 4.5 x 4.5 x 100 pcf = 2025 #

$q_{net} = q_{allowed} - Wt_{footing} - Wt_{soil}$
= 1800 - (2788/20.25) - (2035/20.25) - (1' x 100 pcf)
q_{net} = 1,462 #

4) Using unfactored loads obtain area of footing

$A = \frac{D+L}{q_{net}} = \frac{26,681 + 2,788 + 2035 + 2025}{1,462} = 22.93\ ft^2$

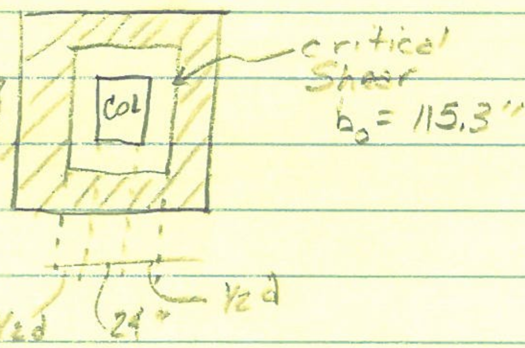
4.5' x 4.5' = 20.25 ft^2 < 22.93 ft^2

Increase to 5' x 5' = 25 ft^2 ∴ OK

5) U = factored Load = 1.2 DL + 1.6 LL + .5 LLR
(1.2×27,700) + (1.6×6775) + (.5×4620) = 46,390
Net Soil Pressure = 46,390 ÷ (5.5×5.5) = 1856 psf

6) Check thickness for 2way Shear
d = footing thickness − bar cover − d bar
= 8" − 2.5" − 0.675 = 4.825

Critical Shear Area = b_o = 4×(Column Width + d)
b_o = 4×(24" + 4.825) = 115.3"



V_u = Soil Net P. [footing width − Critic]
= 2236 psf × [5.5' − (24" + 4.825)/12]
V_u = 6,927

Smallest of ϕV_c

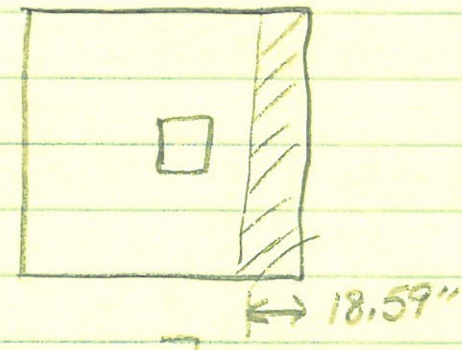
a) $\phi V_c = \phi\,(2 + 4/\beta)\sqrt{f'c} \cdot b_o \cdot d$
$= 0.75(2+4/1)\sqrt{3000} \cdot 115.3 \cdot 4.825$
= 138,541

* b) $\phi V_c = \phi\left(\frac{\alpha_s \cdot d}{b_o} + 2\right)\sqrt{f'c} \cdot b_o \cdot d$
$= 0.75\left(\frac{98 \times 4.885}{115.3}\right)\sqrt{3000} \cdot 115.3 \cdot 4.825$
= 84,830

d) $\phi V_c = 4 \cdot \phi \cdot \sqrt{f'c} \cdot b_o \cdot d$
$= 4 \cdot 0.75 \cdot \sqrt{3000} \cdot 115.3 \cdot 4.825$
= 92,360

Is $\phi V_c > V_u$ 84,830 > 6,927 ∴ OK

7) Check for 1-Way Shear



Critical Width = $\frac{1}{2} b_w - \frac{1}{2} \text{Col wid} - \frac{1}{2} d$

$C_w = \frac{1}{2}(66) - \frac{1}{2}(24) - \frac{1}{2}(4.825")$

$C_w = 18.59"$

V_u = Net Soil Press × [footing width − Critical]

$= 2236 \times \left[5.5' - \frac{18.59}{12}\right] = 8{,}834\ \#$

(1 for normal weight concrete → λ)

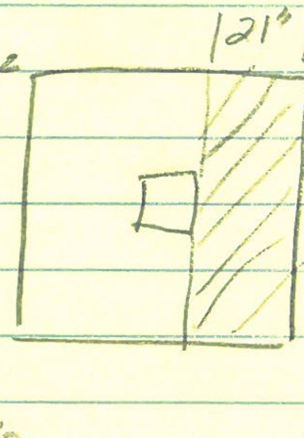
$\phi V_c = \phi \cdot 2 \cdot \lambda \cdot \sqrt{f'_c} \cdot b_w \cdot d$

$= (0.75)(2)(1)(\sqrt{3{,}000}) \cdot (66") \cdot (4.825)$

$\phi V_c = 26{,}163$

Is $\phi V_c > V_u$ $26{,}163 > 8834$ ∴ OK

8) Design flexural reinforcement



M_u = Net Soil Pres × Width × $\frac{(\text{crit width})^2}{2}$

$= 2236 \times 5.5' \times \left(\frac{21}{12}\right)^2 \div 2$

$M_u = 18{,}831$ ft-#

assume $j = 0.9$ & $\phi = 0.9$

$A_s = \frac{M_u \times 12"/ft}{\phi f_y j d} = \frac{18{,}831 \times 12"/ft}{(0.9)(60{,}000)(0.9)(4.825)} = 0.964\ in^2$

$A_{s\,min} = 0.0018\, bh = 0.0018(66")(8) = 0.9504$

5 ea #4 bars = 1.00 in² #4 bar 12" o.c. E/W

9) recompute ϕM_n

$$a = \frac{A_s f_y}{0.85 f'_c b_w} = \frac{(1.0 in^2)(60,000)}{(0.85)(5,000)(66)} = 0.357 in^2$$

$$c = a/\beta_1 = 0.357/0.85 = 0.419''$$

$$M_n = T(d - a/2) = A_s f_y (d - a/2)$$
$$= (1)(60,000)(4.825 - 0.357/2) = 278,790 \text{ in-\#}$$
or 23,232 ft-#

$$\phi M_n = 0.9 M_n = 20,909 \text{ ft-\#}$$

Is $\phi M_n > M_u$ 20,909 ft-# > 18,831 ft-#

∴ Ok

10) Check $\epsilon_t \geq 0.005$

$$\epsilon_t = \frac{0.003(d_t - c)}{c} = \frac{0.003(4.825 - 0.419)}{0.419}$$

$$\epsilon_t = 0.0315 > 0.005 \quad \therefore \text{Ok}$$

11) Check development Length of Steel in footing

Clear Space > 2 d_b

Clear Cover > d_b

$$l_d = \left(\frac{f_y \psi_t \psi_e}{20\sqrt{f'_c}\,\lambda}\right) d_b = \left(\frac{(60,000)(1)(1)}{(20)\sqrt{3000}(1)}\right) .5$$

$$= 27.39''$$

bar length = 66" - 6" = 60"