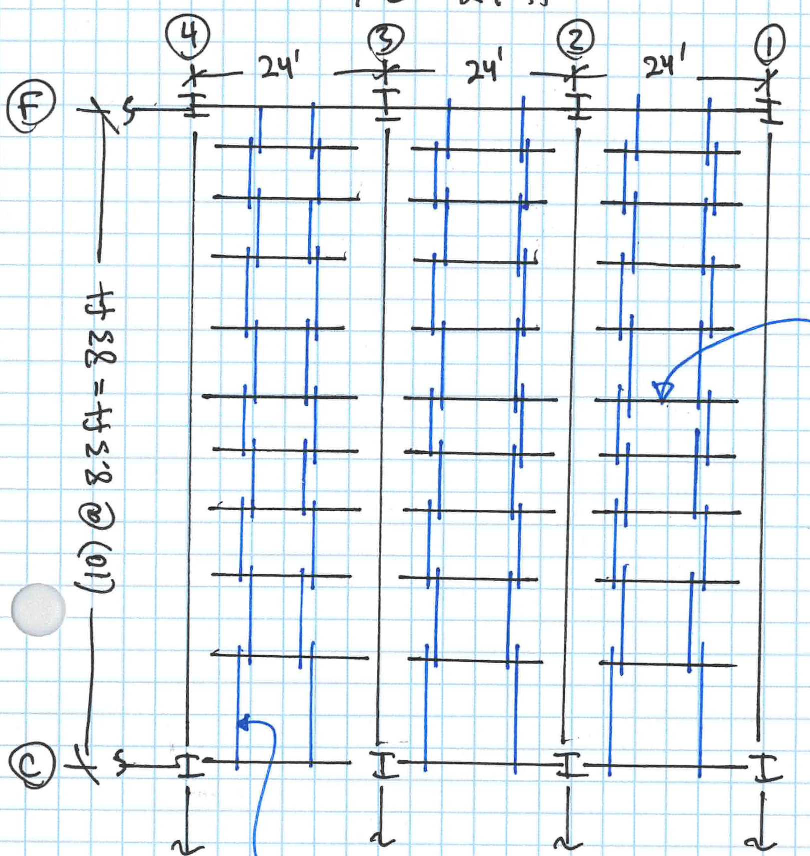
GRAVITY ROOF PURLIN DESIGN (ASD)

- TYPICAL WORST-CASE PURLIN SPACED 8.3 ft O.C. (TRIBUTARY WIDTH)
- TOP FLANGE BRACED CONTINUOUSLY BY ROOF DECK
- BOTTOM FLANGE BRACED AT 1/3 POINTS ($L_b = 8$ ft) BY SAG RODS (FOR WIND UPLIFT)
- LENGTH, L = 24 ft



PLAN: ROOF PURLINS

DL = 20 psf

LL_{roof} = 20 psf

SL = 49 psf

WL_{down} = 12 psf

WL_{uplift} = −43 psf

ASD COMBOS

D = 20 psf

D+L = 20 + 0 = 20 psf

D + (Lr or S or R) = 20 + 49 = 69 psf ← Max Gravity

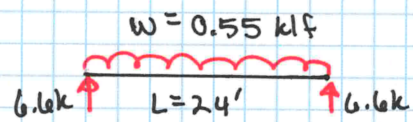
D + 0.6W = 20 + 0.6(12) = 27.2 psf

D + 0.75L + 0.75(0.6W) + 0.75(Lr or S or R)

= 20 + 0 + 0.75(0.6 × 12) + 0.75(49) = 62.2 psf (ignore)

0.6D + 0.6W = 0.6(20) + 0.6(−43) = −13.8 psf ← Max Uplift

MEMBER PR1: GRAVITY CASE



L_b = 1 ft

W_T = 8.3 ft

$w = 62.2\,psf(8.3\,ft) = 516\,plf$

+ self-wt → say w = 0.55 klf

$V = 0.55\,klf(24\,ft)/2 = 6.6\,k$

$M = \frac{0.55\,klf(24\,ft)^2}{8} = 40\,k \cdot ft$

$\Delta_{allow} = \frac{L}{360} = \frac{24(12)}{360} = 0.8''$ (limit ponding)

$I_{xx_{req}} = 0.000776\left(\frac{0.55\,klf \cdot (24\,ft)^4}{0.8\,in}\right) = 177\,in^4$

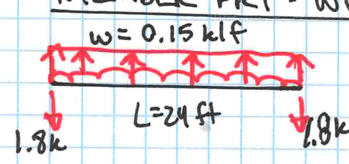
USE W12×26

$I_{xx} = 204\,in^4$

$V_n/\Omega = 56k$

$L_b = 1\,ft$ @ $M_n/\Omega = 92.8\,k \cdot ft$

MEMBER PR1: WIND UPLIFT CASE



L_b = 8 ft

W_T = 8.3 ft

$w = 13.8\,psf(8.3\,ft) = 115\,plf$

→ w = 0.15 klf

$V = 0.15(24)/2 = 1.8\,k$

$M = 0.15(24^2)/8 = 10.8\,k \cdot ft$

$I_{x_{req}} = 0.000776\left(\frac{0.15 \cdot 24^4}{0.8}\right) = 48\,in^4$

USE W12×26 — OK for uplift

$I_{xx} = 204\,in^4$

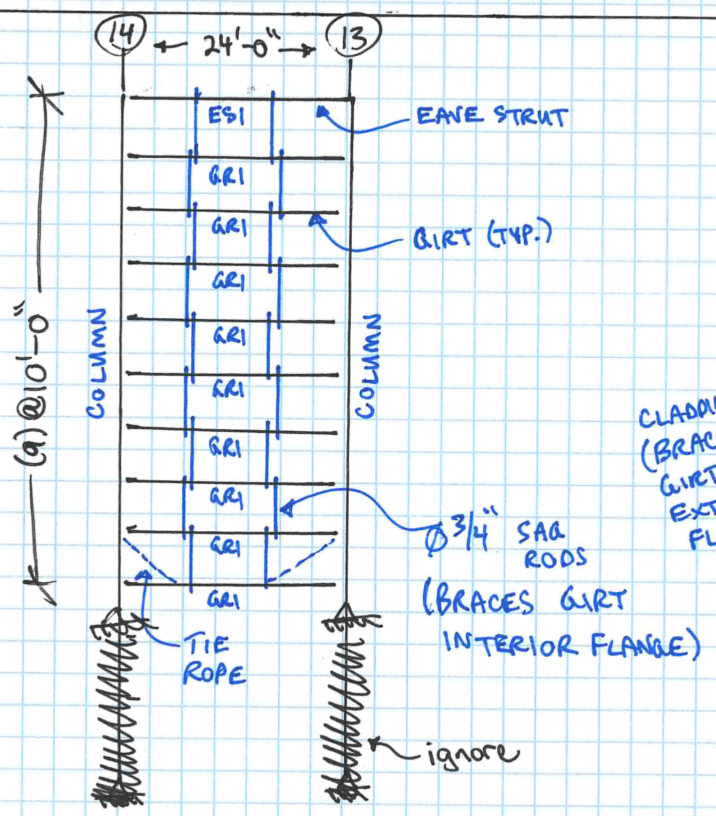
$V_n/\Omega = 56k$

$L_b = 8\,ft$ @ $M_n/\Omega = 83.2\,k \cdot ft$

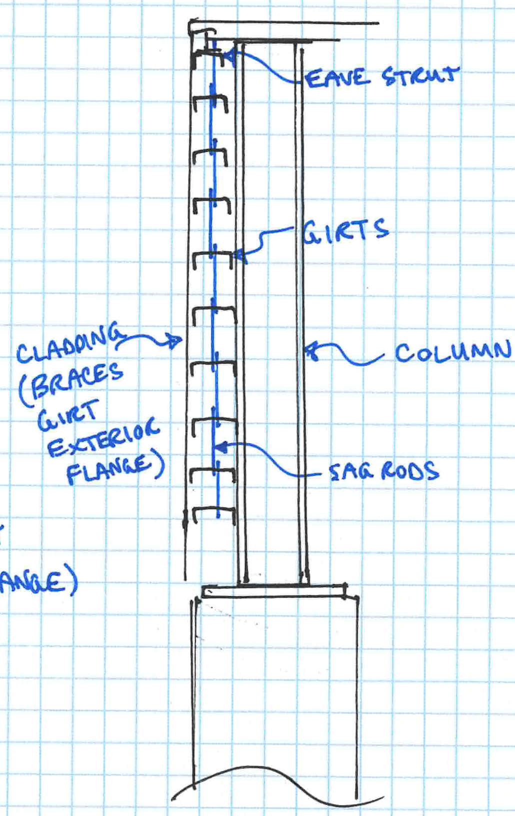
Note: $M_n/\Omega = 28.4\,k \cdot ft$ @ $L_b = 24\,ft$

WALL GIRT DESIGN (ASD)

- ASSUME HORIZONTAL WALL GIRT SPACING IS 10 ft O.C. (TRIBUTARY WIDTH = 10 ft) LENGTH = 24 ft (COLUMN TO COLUMN)
- GIRTS TAKE PRESSURE & SUCTION WIND LOADS IN STRONG-AXIS BENDING
- WALL CLADDING IS ATTACHED TO GIRTS TO BRACE OUTER FLANGE. CLADDING SELF-WEIGHT IS SUPPORTED BY EAVE STRUT THROUGH TENSION LOADING OF THE SAG RODS INSTALLED BETWEEN GIRTS. CLADDING IS ASSUMED TO NOT CAUSE MINOR-AXIS BENDING OF GIRTS. GIRT SELF-WEIGHT CAUSES SOME MINOR-AXIS BENDING (THIS COULD ALSO BE SUPPORTED BY SAG RODS & EAVE STRUTS IF NEEDED FOR DESIGN).
- (2) SAG RODS INSTALLED AT THIRD POINTS ($L_b = 8$ ft) BETWEEN GIRTS TO LATERALLY BRACE GIRT INNER FLANGES WHEN SUCTION WIND LOAD ACTS ON GIRT & CAUSES INNER FLANGE TO GO INTO COMPRESSION. SAG RODS = ϕ 3/4" STEEL RODS w/ THREADED ENDS



TYPICAL ELEVATION
(NOT TO SCALE)



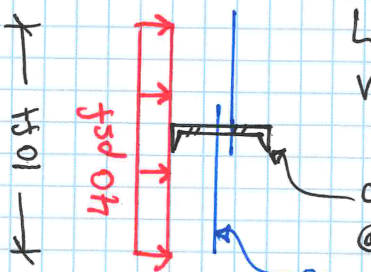
SECTION: (NOT TO SCALE)

NOTE:
CLADDING DEAD LOAD IS CARRIED BY SAG RODS IN TENSION & PICKED UP BY EAVE STRUT.
GIRT DEMANDS ARE PRESSURE & SUCTION WIND LOADS IN STRONG-AXIS BENDING

WALL GIRT DESIGN (ASD)

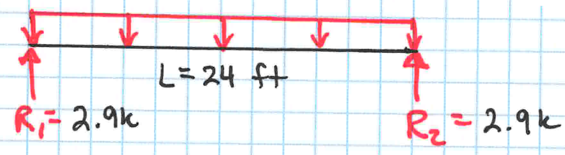
(EXTERIOR FLANGE IN COMPRESSION)

CASE 1 : PRESSURE WIND



$L_b = 1\ ft$ → CONTINUOUS BRACING BY EXTERIOR CLADDING

$W_T = 10\ ft$



WIND, $W = 40\ psf$

ASD COMBO : $0.6W = 0.6(40) = \underline{24\ psf}$

$w = 24\ psf\ (10\ ft) = 240\ plf = 0.24\ klf$

$R = V = \frac{wL}{2} = \frac{0.24\ klf(24\ ft)}{2} = \underline{2.9k}$

$M = \frac{wL^2}{8} = \frac{0.24\ klf(24\ ft)^2}{8} = \underline{17.3\ k\cdot ft}$

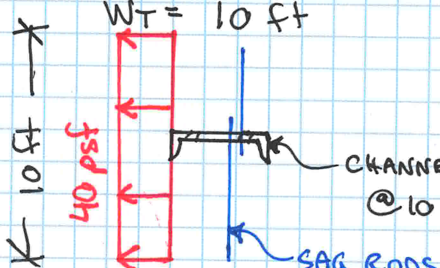
$\Delta_{allow} = \frac{L}{360} = \frac{24'(12''/ft)}{360} = 0.8\ in$

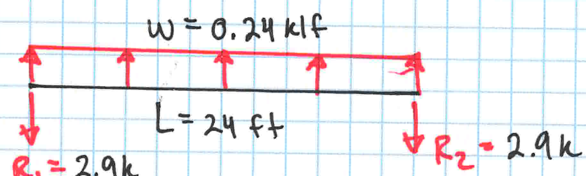
$I_{x_{req}} = \frac{5}{384} \cdot \frac{0.24\ k}{ft} \cdot \frac{24^4\ ft^4}{29{,}000\ k} \cdot \frac{in^2}{0.8\ in} \cdot \frac{1728\ in^3}{ft^3} = \underline{77\ in^4}$

CASE 2: SUCTION WIND (INTERIOR FLANGE IN COMPRESSION)

$L_b = 8\ ft$ (BRACING BY SAG RODS @ 1/3 POINTS)

$W_T = 10\ ft$





DEMANDS SAME AS CASE 1

$R = V = 2.9k$

$M = 17.3\ k\cdot ft$

$\Delta_{allow} = 0.8\ in$

$I_{x\ req} = 77\ in^4$

CASE 2 CONTROLS WITH $L_b = 8\ ft$

OPTIONS: CAN USE C12 or SMALLER

C10×20 $I_x = 78.9\ in^4$ $M_n/\Omega = 27\ k\cdot ft$ @ $L_b = 8\ ft$

C10×25 $I_x = 91.1\ in^4$ $M_n/\Omega = 34\ k\cdot ft$ @ $L_b = 8\ ft$

C12×20.7 $I_x = 129\ in^4$ $M_n/\Omega = 36\ k\cdot ft$ @ $L_b = 8\ ft$ ← SELECT (HIGHEST STIFFNESS & CAPACITY & SECOND LIGHTEST)

USE C12×20.7 GIRT

$I_x = 129\ in^4 > I_{x\ req} = 77\ in^4$

$M_n/\Omega = 36\ k\cdot ft > M_r = 17.3\ k\cdot ft$