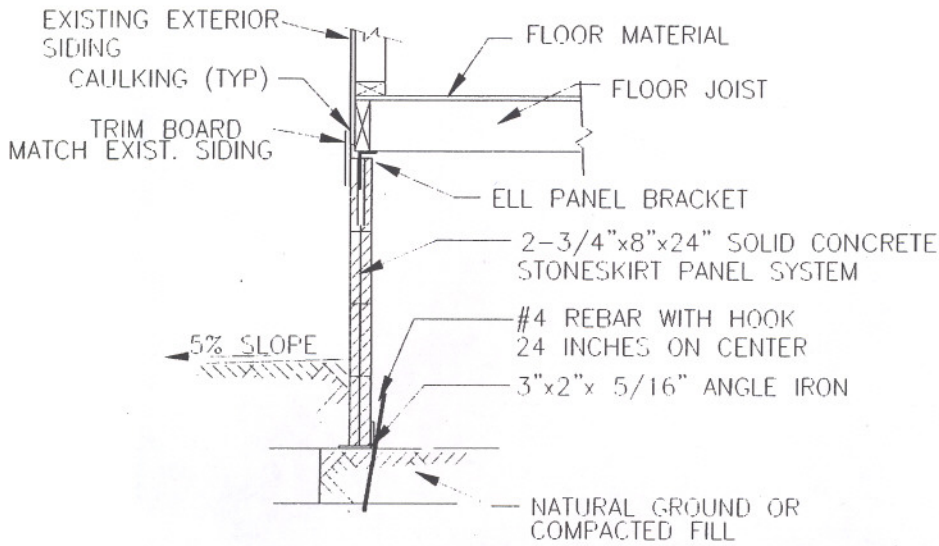
Manufactured Housing
Solid Concrete Block Retaining Wall Design Calculations
Angle Iron Bottom Support



PERIMETER SIDEWALL DETAIL

Use Coulomb's general equation for active earth load on a retaining wall:

$$P = \tfrac{1}{2}\, wH^2 \frac{1-\sin\phi}{1+\sin\phi}$$

Where:

P = total pressure per linear foot of wall in lbs.
w = specific (unit) weight of soil in lbs. per cu. Ft.
H = height of wall in ft.
ϕ = angle of internal friction of the soil

Soils = Fine Silty Sands to Silty Sands to Sandy Loams
w = 110 pcf
ϕ = 35° increases with compression

Maximum depth of fill on the wall is 12 inches. Add a two-foot surcharge for this design; this is approximately equivalent to a heavy backhoe tractor that might be expected to operate close to the top of the wall during construction operations.

$$P = \tfrac{1}{2}\,(110\ \text{pcf})(3.0')^2\left(\frac{1-\sin 35^\circ}{1+\sin 35^\circ}\right)$$

P = 134.15 lbs. acting 4.0" above the base

Compute Equivalent Fluid Pressure

$\tfrac{1}{2}wH^2$ = 134.14 lbs.

$w = 134.14 \times 2 / (3.0')^2 = 29.8$ psf

The top of the wall is attached by the ell bracket to the manufactured home. Calculate the reactions R_1 and R_2 at the top and bottom of the wall by calculating moments about R_1.

$R_2(32") = P(28.0")$ therefore $R_2 = 117.37$ lbs.

$R_1 = P - R_2 = 16.78$ lbs.

Check Maximum length of angle between support points (vertical rebar).

Angle Iron Properties:
Weight = 1.79 lb./ft.
Area = 1.47 sq. in.
I = moment of inertia = 1.29 $in.^4$
S = section of modulus = 0.65 $in.^3$
Tensile Strength = 18,000
E = modulus of elasticity = 28,600,000

Calculate Resisting Moment of Angle (M_r)

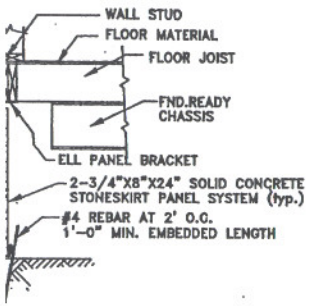
$S = I/c$
$c = 1.29/0.65 = 1.98$
$M_r = x\ I/c = (18,000)(1.29)/1.98 = 11,727$ in-lb

Solve for Maximum Length (l) in Bending Moment Formula

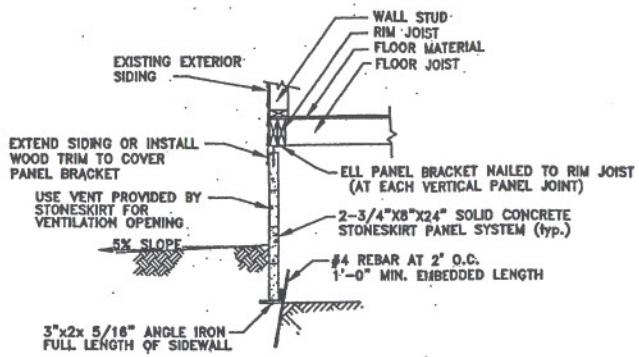
$W = 117.37$ lb./ft = 9.78 lb./in.
$M = w l^2 / 8$
$l = ((11,727)(8)/9.78)^{.5} = 98$ inches
Set vertical rebar at 24 inches on center,
Safety Factor = 98"/24" = 4.08

Resistive force of the rebar in the ground will be the limiting factor to determine the distance between rebar. Weight supported by each rebar that is driven into the ground at 24" on center (o.c.).

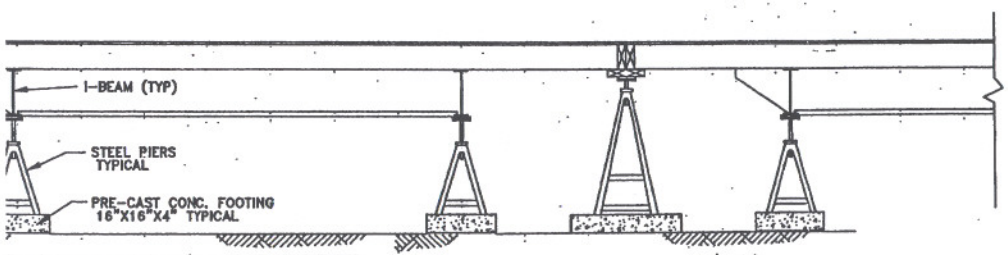
Wt = (24")(9.78 lb/in) = 234.72 lb.
Mo = (2")(234.72) = 469.44 in-lb
Mr = (.94 lb.)(2")(2/3) + (59 lb.)(10")(1/2) = 296.25 lb.
Resistive Force of rebar in ground is OK for 24" spacing.



ER ENDWALL DETAIL
CALE: 3/4"=1'0"

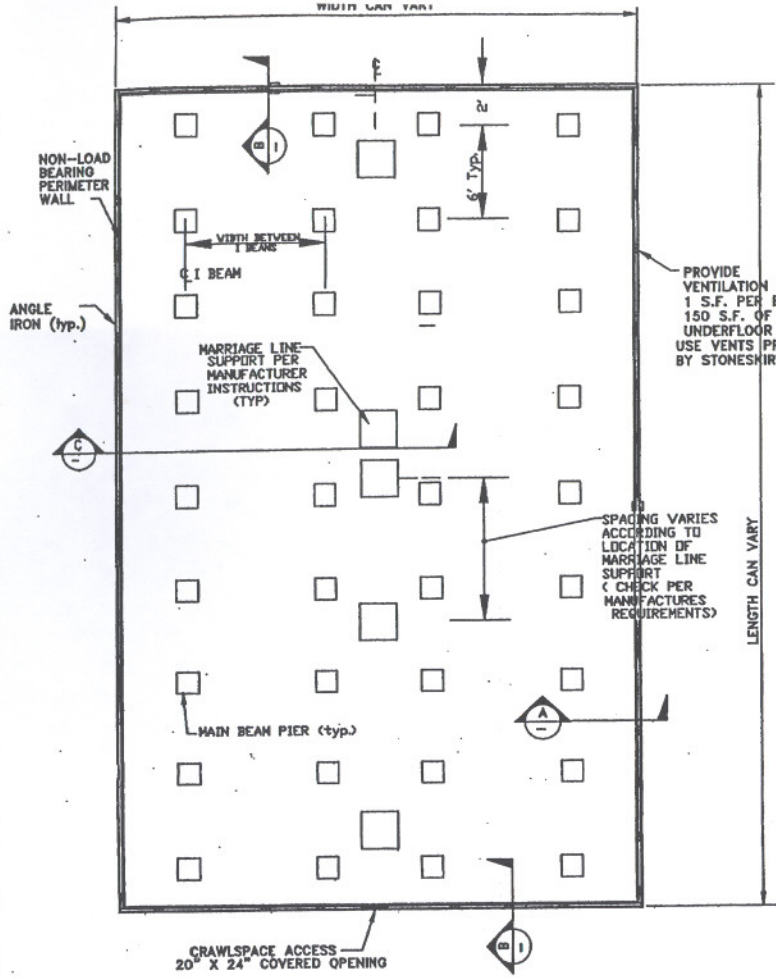


A PERIMETER SIDEWALL DETAIL
SCALE: 3/4"=1'0"



E: CONCRETE BLOCK PIERS MAY BE SUBSTITUTED
THE STEEL PEIR, USE SAME CONCRETE PAD FOOTING.
GLE BLOCK PIER (8000# MAX. CAPACITY, 36" MAX. HEIGHT)
IBLE BLOCK PIER (16000# MAX. CAPACITY, 80" MAX. HEIGHT)

C VECTOR FOUNDATION SYSTEM PIER AND FOOTING DETAIL
NO SCALE



GENERAL RETAINING WALL PLAN
NO SCALE

OLE IRON BASE

EM

DESIGN NOTES

1. WIND LOADS –
   ASSUME DESIGN WIND SPEED OF 80 mph.
   TO CONVERT MPH TO A BASIC WIND VELOCITY PRESSURE (q) IN PSF,
   $q = 0.00256 \times Kz \times V^2$
   WHERE V IS BASIC WIND SPEED AND Kz IS VELOCITY PRESSURE COEFFICIENT = 0.8
   $q = 0.00256 \times 0.8 \times (80)^2 = 13.11$ PSF
   DESIGN WIND PRESSURES (p) ARE BASED ON EXTERNAL AND INTERNAL EFFECTS UTILIZING THE FOLLOWING EQUATION:
   $p = (q \times Gh \times Cp) - (q \times GCpi)$
   WHERE (Gh) THE GUST RESPONSE FACTOR = 1.32 AND (GCpi) THE INTERAL PRESSURE = .25 AND (Cp) EXTERNAL PRESSURE COEFFICIENTS = –0.9 (windward) and –0.7 (leeward).
   $p = (13.11 \times 1.32 \times -0.9) + (13.11 \times .25) = -18.85$ PSF ON THE WINDWARD SIDE
   $p = (13.11 \times 1.32 \times -0.7) - (13.11 \times .25) = -15.39$ PSF ON THE LEEWARD SIDE
   WIND PRESSURES AND SUCTIONS ARE TYPICALLY TREATED AS UNIFORMLY DISTRIBUTED AND TYPICALLY APPLIED PERPENDICULAR TO THE ORIENTATION OF ANY PLANAR SURFACE.
   THE VERTICAL PRESSURE COMPONENT (Pv) EQUALS THE PRESSURE (p) TIMES THE HORIZONTAL LENGTH OF THE SLOPE. A NEGATIVE PRESSURE INDICATES UPLIFT (WORKING AGAINST GRAVITY)
2. REQUIRED VERTICAL ANCHORAGE (Av) BASED ON OVERTURNING FORCES DUE TO WIND AND THE HOME DEAD LOADS PROVIDING RESISTANCE. THE OVERTURNING PIVOT POINT IS LOCATED AT THE EXTERIOR MAIN FRAME BEAM AND PIERS ON THE LEEWARD SIDE.
   UPLIFT IS WIND PRESSURE WORKING AT A LEVERAGE DISTANCE FROM THE PIVOT POINT.
   $Mo = (Pt \times Hn) + ((Prw \times (3 \times Wt/2)) + ((Pvl \times (Wt/2)) = 7202.83$ ft–lb
   THE TOTAL DEAD LOAD PROVIDES THE ONLY GRAVITY LOAD RESISTANCE TO OVERTURNING.
   $Mr = DL \times Wt = 7928.2$ ft–lb, WHERE DL IS THE LIGHT DEAD LOAD FOR A MULTI–SECTION UNIT.
   $Av = (1.5 \times Mo - Mr)/(2 \times Wt) = 102.72$ lb/ft. THE VECTOR SYSTEM USES THE BUILDING STRUCTURE TO TRANSFER PIER LOADS INTO CLEATED FOUNDATION PADS. THE WIND LOADS ARE TRANSFERRED FROM THE WIND SIDE OF THE HOME THROUGH DIAGONAL CROSS TIES TO THE OPPOSITE LEE SIDE CLEATED FOUNDATION PADS. AS WIND LOADS INCREASE, LEE SIDE PIER FORCES ALSO INCREASE WHICH INCREASES THE VECTOR PADS' (LEE SIDE) RESISTANCE TO HORIZONTAL MOVEMENT. THERE IS NO VERTICAL RESISTANCE.

GENERAL NOTES:

1. PERIMETER WALL SHALL BE STONESKIRT PANEL SYSTEM CONSISTING OF THE STONESKIRT CONCRETE PANEL, THE I–BEAM TO CONNECT THE PANELS, THE ELL BRACKET ATTACHED TO THE RIM JOIST AND THE BASE BLOCK.
2. USE VECTOR DYNAMICS FOUNDATION SYSTEM FOR WIND ZONE 1 INSTALLATION INSTRUCTIONS.
3. USE 4 VECTOR SYSTEMS FOR ALL MANUFACTURED HOME LENGTHS.
4. ADDITIONAL INFORMATION MAY BE OBTAINED FROM TIE DOWN ENGINEERING, 5901 WHEATON DRIVE, ATLANTA, GA 30336. PHONE # 404.344.0000, FAX # 404.349.0401
5. PROVIDE ONE 20"x 24" CRAWL SPACE ACCESS. PROVIDE CRAWL SPACE VENTS SCREENED WITH 1/4" MESH AT THE RATE OF 1 SQ. FT. OF VENT AREA PER 150 SQ. FT. OF UNDERFLOOR AREA.
6. CONTRACTOR SHALL VERIFY ALL SITE CONDITIONS AND DIMENSIONS BEFORE STARTING WORK. CONCRETE PADS UNDER PIERS SHALL BE SIZED BASED ON ALLOWABLE SOIL BEARING PRESSURE AND THE LOAD EACH PIER HAS TO CARRY.
7. DESIGN LOADS:

ROOF LIVE LOAD	20 P.S.F.
FLOOR LIVE LOAD	40 P.S.F.
WIND LOAD	20 P.S.F.
SEISMIC	ZONE 2a
SOIL BEARING	1000 P.S.F.

8. THE DESIGN CONFORMS TO THE UNIFORM BUILDING CODE (UBC) 1997 EDITION; AND THE STATE OF ARIZONA RULES TITLE 4, CHAPTER 34, ARTICLE 2.

Job No.
Designed
Drawn
Checked
Reviewed
Approved
Reg. No.

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FACTORY MANUFACTURED HOUSING
STONESKIRT CONCRETE PERIMETER WALL

STONESKIRT STANDARD ANGLE IRON BASE FOUNDATION SYSTEM
PLAN & DETAILS

DRAWING NO. 1 RE