OCEAN TOWNSHIP HIGH SCHOOL
OCEAN, NEW JERSEY
ALLAN BLOCK FENCE DESIGN

No.	Date	Revision	By

Designed By: RJL	Title: Title Sheet		Date: 02/28/2004
Checked By: SLH	Project:	Ocean Township High School Ocean, NJ	Project No: 055.05
Scale: Not To Scale			Page No: 1 OF 5

AB FENCE SYSTEM GENERAL NOTES:

1. CONSTRUCTION OF THE AB FENCE SYSTEM SHALL BE IN ACCORDANCE WITH THE "AB FENCE SYSTEM INSTALLATION GUIDE."

2. CONSTRUCTION INSPECTION SHALL INCLUDE BUT NOT BE LIMITED TO PILE EXCAVATION, CONCRETE POURING, REINFORCEMENT PLACING, GROUT PLACING AND AB FENCE BLOCK INSTALLATION.

3. AB FENCE DESIGN IS BASED ON THE FOLLOWING DESIGN CRITERIA:
   a. WIND SPEED: 80 MPH (PER SITE PLAN REQUIREMENTS)
   b. EXPOSURE B (SECTION 6.5.6.3 ASCE 7-00)
   c. ALLOWABLE FOUNDATION AND LATERAL PRESSURE SHALL MEET OR EXCEED VALUES FOR CLASS #4, S1 = 150 psf, SOIL TYPE PER TABLE 1803.2 OF THE IBC. SOIL PARAMETERS SHALL BE VERIFIED BY A GEOTECHNICAL ENGINEER.

4. PROVIDE TEMPORARY LATERAL SUPPORT FOR ALL WALLS UNTIL WALLS ARE ADEQUATELY BRACED.

5. UNLESS NOTED OTHERWISE, REINFORCED POSTS ARE CENTERED ON THE CONCRETE PILE FOOTINGS.

TABLE 1.1: AB FENCE SYSTEM DESIGN REQUIREMENTS

FENCE HEIGHT, COURSES	PANEL LENGTH, BLOCK	VERTICAL STEEL	HORIZONTAL STEEL	HORIZONTAL STEEL COURSING, Bn	PILE DIAMETER	PILE DEPTH
Post - 11 Block = 7.35 ft Panel - 10 Block = 6.68 ft	13.79 ft 8.5 block	4 Number four bars	2 Number four Bars	1 & 9	2 ft	4 ft

No.	Date	Revision	By

Designed By: RJL
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Scale: Not To Scale

Title: Design Requirements
Project: Ocean Township High School
Ocean, NJ

Date: 02/28/2004
Project No: 055.05

SPECIFICATION GUIDELINES: AB Fence System

SECTION 1

Part 1: GENERAL

1.1 Scope

Work includes furnishing and installing modular concrete block fencing system to the heights and lengths specified on the construction drawings and to the specifications listed herein.

1.2 Reference Standards

ASTM C1372-97 Standard Specifications for Segmental Retaining Wall Units.

1.3 Delivery Storage, and Handling

A. Installer shall check the materials upon delivery to assure proper material has been received.
B. Installer shall prevent excessive mud, concrete, and like materials from coming in contact with the materials.
C. Materials shall be protected from damage once on site. Damaged materials including cracked and chipped block beyond allowances provided for in ASTM C1372-97 must not be used in the fence.

Part 2: MATERIALS

2.1 AB Fence System Units

A. System units shall be AB Fence Post, Panel and Cap units as produced by a licensed Manufacturer.
B. System units shall have a minimum 28 day compressive strength of 3000 psi (20.7 Mpa) in accordance with ASTM C 1372-97. The concrete units shall have adequate freeze-thaw protection with an average absorption rate of 7.5 lb/ft3 (120 kg/m3) for northern climates and 10 lb/ft3 (160 kg/m3) for southern climates.
C. Exterior dimensions shall be uniform and consistent. Maximum dimensional deviations shall be 1/8 in (3 mm), not including textured face.
D. Exterior shall be textured or striated or a combination of both. Color as specified by the project owner.

2.2 Pile Concrete

A. Concrete used to construct the piles must have a minimum compressive strength of 3000 psi (20.7 MPa).

2.3 Concrete Grout

A. Concrete grout used as unit core fill shall conform to ASTM C476 and have a minimum compressive strength of 3000 psi (20.7 MPa) with Fine Aggregate Grading Requirements defined by ASTM C404.

2.4 Steel Reinforcement

A. All reinforcing bars shall be deformed billet steel conforming to ASTM A615 grade 60. Bars shall be branded by the manufacturer with bar size and grade of steel, and certified mill reports shall be submitted for record.

2.5 Construction Adhesive

A. Exterior grade construction adhesive used to adhere the cap block to both the posts and panels shall be PL Premium as manufactured by OSI Sealants Inc. (or equivalent) with a minimum shear strength of 300 psi (2.0 MPa).

2.6 Shimming Material

A. Material used for shimming must be non-degradable.

Part 3: SYSTEM CONSTRUCTION

3.1 Layout

A. Excavate a 6 in (150 mm) deep by 12 in (300 mm) wide trench along the centerline of the AB Fence the entire length of the fence.
B. The center of each pile hole must be located and drilled to a maximum horizontal tolerance of ±1 in (25 mm). The depth and diameter must be at least that specified in design.
C. The top of the pile holes shall be set to approximately 1/2 in (13 mm), 1 in (25 mm) maximum, below the design elevation of the pile. A mortar bed is required for the placement of the first post block. 12 in (300 mm) of cylindrical tubing material is recommended to form up the top of the hole for setting the elevation.

3.2 Pile Construction

A. Pour concrete into the pile hole meeting the strength requirements for the pile concrete to meet the specification listed in 3.1-C.
B. Place vertical steel reinforcement into the wet pile concrete within 0.5 in (13 mm) of the design horizontal location for the steel. The steel bars must extend into the pile to the depth specified in the design with a minimum clear cover at the bottom of the pile of 3 in (75 mm). The steel bars must also extend out the top of the pile minimum distance to achieve a lap splice equal to 20 times the bar diameter.
C. Allow the concrete to harden 4 hrs at or above 40° F (4.4° C) or until hard enough to resist more than a surface scratch when scraped with steel rebar before placing post block.

3.3 Post and Panel Construction

A. Fill trench between each post the design elevation of the bottom of the fence with a well graded compactable aggregate to 90% Standard Proctor.
B. Set the first post block on a mortar bed with with ASTM Type N mortar and maximum thickness of 1 in (25mm).
C. The panels must extend a minimum of 1 in (25 mm) into the post block columns.
D. Horizontal steel reinforcement must be installed in the specified bond beam locations. The horizontal steel must have a 3 in (75mm) clear cover at each end.
E. The panel block must be stacked in a running bond pattern.
F. All post block and panel block above and below the bond beam locations must be filled with concrete grout meeting the strength requirements, and consolidation with a concrete vibrator.
G. Minimum curing time for concrete grout is 4 hrs for the bottom bond beam and 2 hrs for all other locations.
H. Maximum stacking lifts and filling for the post blocks is 4 ft (2.4 m). Vertical steel reinforcement shall maintain a 1 in (25 mm) clear cover from all inside surfaces of the post block. Minimum lap splice requirements are 20 times the bar diameter.
I. Panel block must be stacked from bond beam to bond beam and filled with concrete grout concurrently.

No.	Date	Revision	By

Designed By: RJL	Title: Specifications		Date: 02/28/2004
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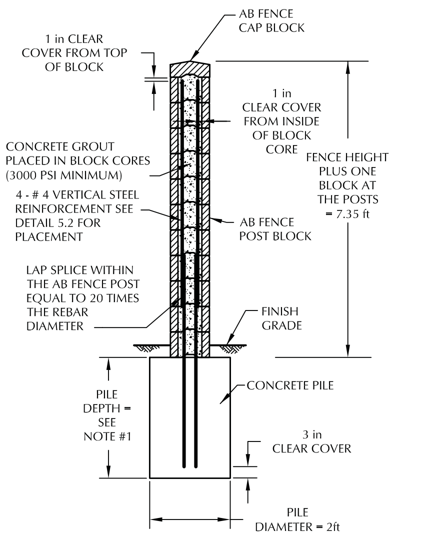
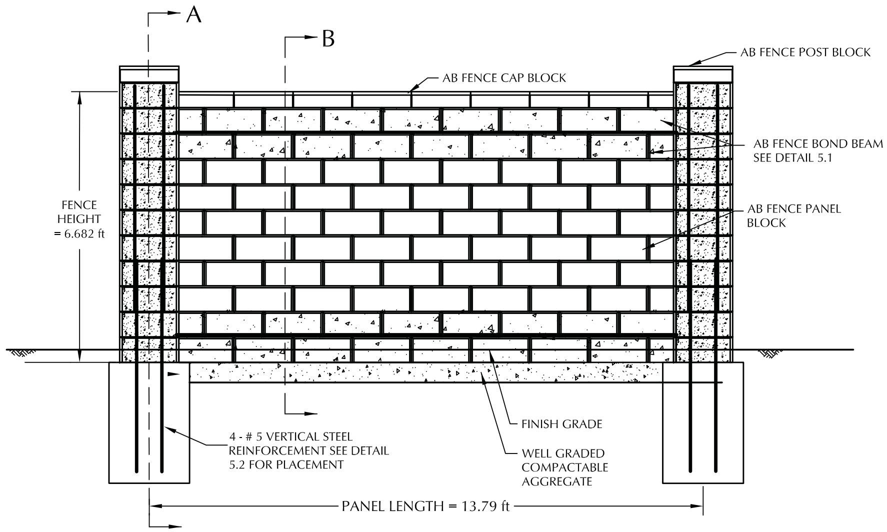
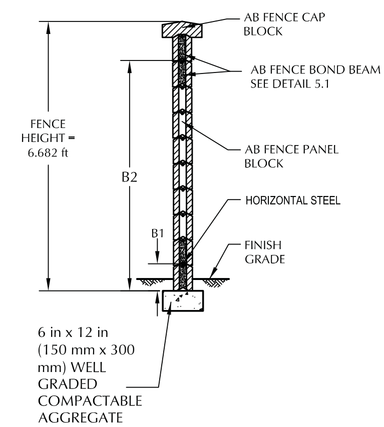


A
-
AB FENCE POST SECTION
PANEL TYPE A



AB FENCE PANEL ELEVATION
PANEL TYPE A



B
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AB FENCE PANEL SECTION
PANEL TYPE A

NOTE 1:

FOOTING DEPTH TO BE BASED ON
MINIMUM FROST DEPTH OR 4
FOOT MINIMUM.

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Designed By: RJL	Title: Construction Details	Date: 03/29/2004
Checked By:	Project: Ocean Township High School Ocean, NJ	Project No: 074.05
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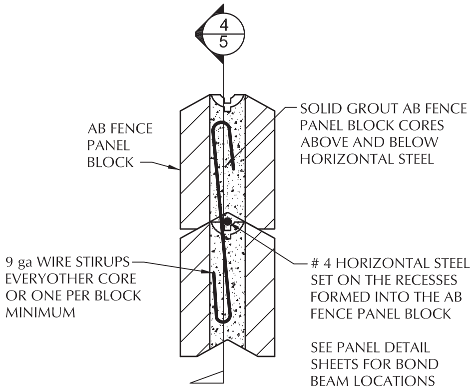
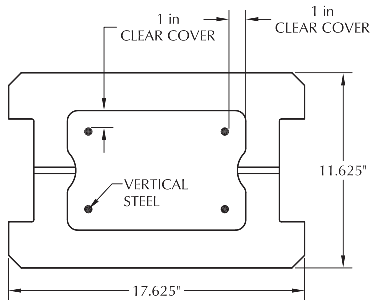
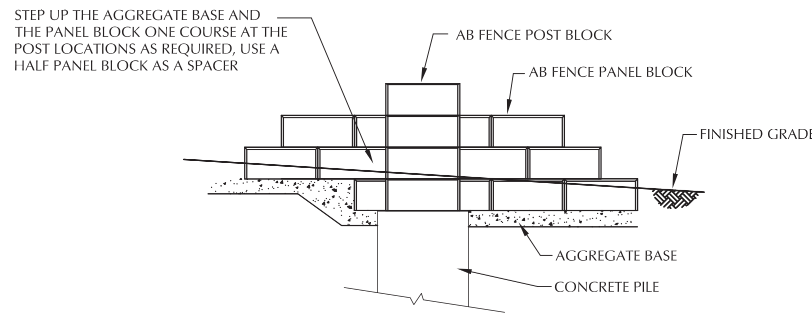


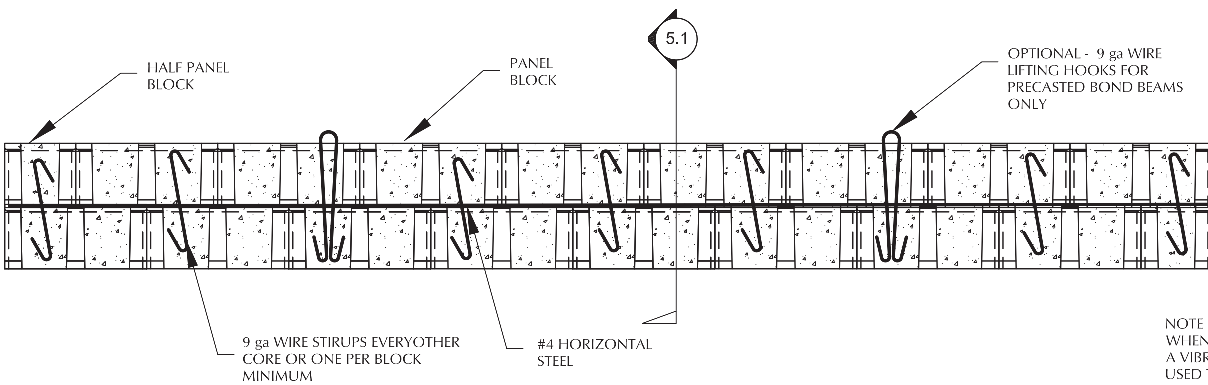
5.1 BOND BEAM



5.2 VERTICAL STEEL PLACEMENT



5.3 AB FENCE PANEL STEP DOWN



NOTE 1:
WHEN PLACING SAND MIX GROUT, A VIBRATORY STINGER SHOULD BE USED TO AID IN THE PROPER CONSOLIDATION OF GROUT.

4/5 LONGITUDINAL CROSS SECTION

No.	Date	Revision	By

Designed By: RJL	Title: Construction Details	Date: 03/29/2004
Checked By:	Project: Ocean Township High School Ocean, NJ	Project No: 074.05
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Fence Design Hand Calculations

Project Name: Ocean Township High School **Project Number: Preliminary**	**Date:** **Designed by: RJL**	**Fence Number:** **Section Number:**

****Input variables are in boxed areas****

Allan Block Parameters:

Wall Length: $\boxed{Wl := 15.3 \cdot ft}$

Course height: $h := 0.6354ft$

Panel Block depth: $t := 0.469ft$

Panel Block length: (See Table 1) $w := 1.4688ft$

Post Block length: $Pl := 1.4688ft$

Post Block depth: (See Table 1) $Pd = 0.9688\,ft$

Post Block Notch depth: (See Table 1) $Pnd = 0.125\,ft$

Corner Post Block Length: $Pc := 1.0ft$

Amount of grout per post block: $PostGrout = 48 \cdot lbf$

Post Block Selection:

Small Post = 1 Large Post = 2

$\boxed{Post := 1}$

Table 1

Post Block Options	
Small Post Block	Pd =0.9688 ft
	Pnd =0.125 ft
	PostGrout = 48 lbf
Large Post Block	Pd =1.6667 ft
	Pnd =0.1667 ft
	PostGrout = 98 lbf

Wind Pressure Entered by Engineer

If you do not want the spreadsheet to calculate wind pressures based on wind speed and exposure coefficients, you can enter a design wind Pressure. If so, enter your design wind pressure as DWP and skip to pages 4 and 5. Otherwise leave the DWP as 0.0 psf and fill in the entire spreadsheet.

$\boxed{DWP := 0.0psf}$

Fence Parameters:

Number of full size block per panel to determine length: $\boxed{s := 8.5}$

$PanelL := s \cdot w$

Panel Length Only: $PanelL = 12.4848\,ft$

Post Spacing - Center of Post Block to Center of Post Block

$$s1 := s \cdot w + 2(0.1875in + 0.25in) - 2 \cdot Pnd + 2 \cdot \left(\frac{Pl}{2}\right)$$

$s1 = 13.7765\,ft$

Tributary Area:

$Ta := s1 \cdot H$ $Ta = 92.456\,ft^2$

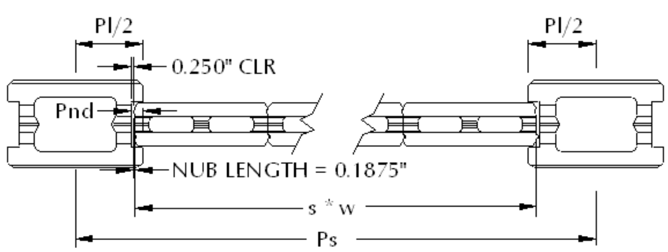
Number of block in each post: $\boxed{PostH := 11}$

$PH := PostH \cdot h + 4.75in$ $PH = 7.385\,ft$

Number of block for panel height: $\boxed{z := 10}$

Panel Fence height:

$H := (z - 1) \cdot h + 7.16 \cdot in + 4.75 \cdot in$ $H = 6.711\,ft$



Input Parameters for Footing Dimensions

Footing Depth: $\boxed{d2 := 4.0 \cdot ft}$ Footing Diameter: $\boxed{b := 2ft}$

Input Parameters for a Retaining Fence:

SOIL PARAMETERS

Friction Angle: $\boxed{\phi i := 30deg}$

Unit Weight: $\boxed{\gamma i := 120pcf}$

BACKSLOPE PARAMETERS

Backslope angle: $\boxed{i := 0deg}$

Height of soil: $\boxed{Hs := 0ft}$

SURCHARGE PARAMETERS

Surcharge: $\boxed{q := 0psf}$

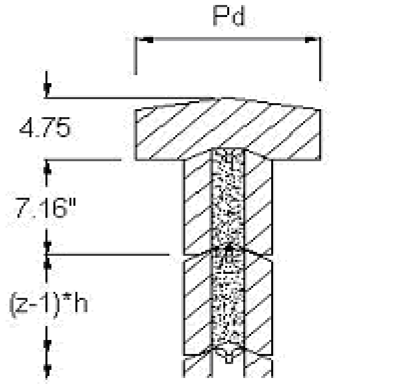


Figure 1: Typical top bond beam

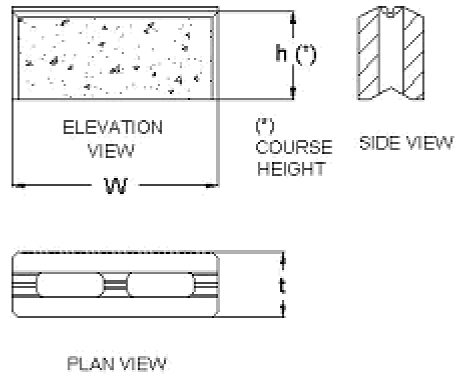


Figure 2: Panel Block

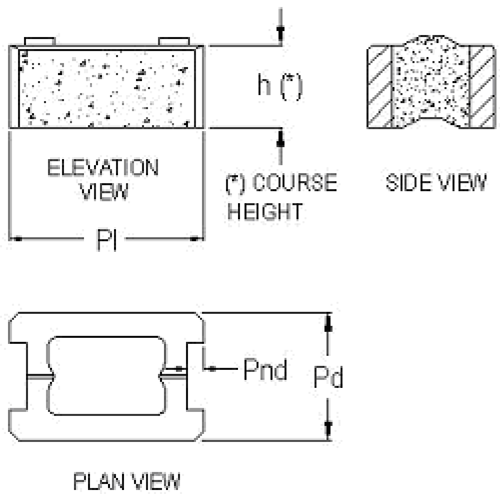


Figure 3: Post Block

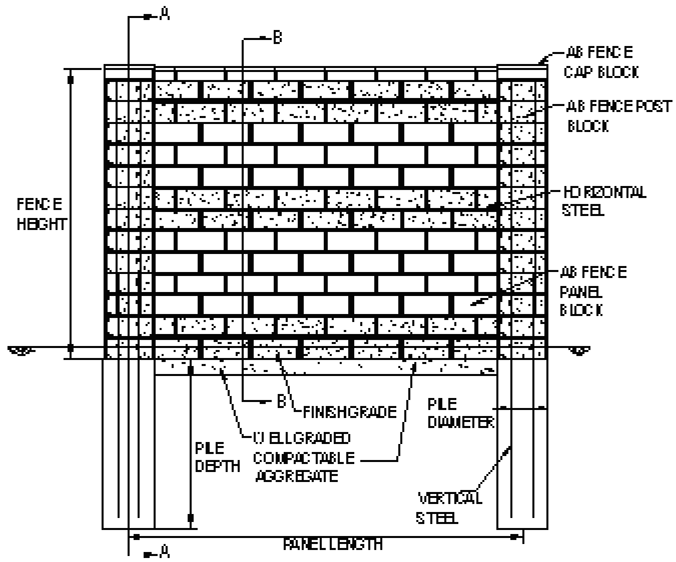


Figure 4: AB Fence Typical Panel Elevation

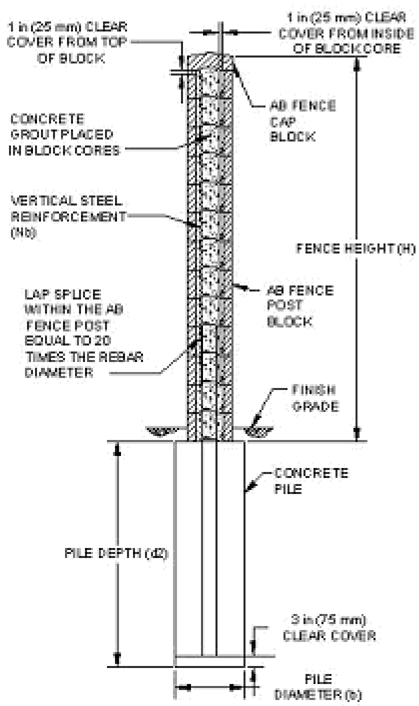


Figure 5: Post Section A - A

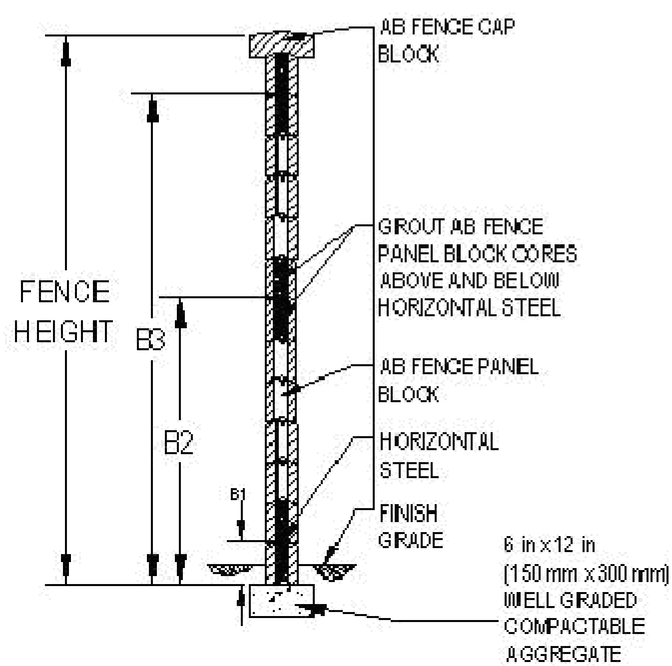


Figure 6: Panel Section B - B

Reinforcement Parameters:

Post:

Quantity number of rebar in post: $\boxed{Nb := 4}$

Post bar Size: $\boxed{size := 4}$

Radius of bar: $r := \frac{(size \cdot in)}{2 \cdot 8}$

$r = 0.25 \cdot in$

Bond Beam:

Quantity number of bond beams: $\boxed{Nbb := 2}$

Bond beam bar Size: $\boxed{sizebb := 4}$

Radius of bar: $rbb := \frac{(sizebb \cdot in)}{2 \cdot 8}$

$rbb = 0.25 \cdot in$

Foundation Design for Pilaster:

Allowable foundation and lateral pressure:

NOTE:
This Foundation Design section is used for both the UBC 97 and the self calculated wind pressure value.

UBC Table 18-I-A-Allowable Foundation and Lateral Pressure

Class of Materials[1]	Lateral Bearing lbs/ft^2/ft of Depth below natural grade[3] (S1)
1.Massive crystalline bedrock	1,200
2. Sedimentary and floiated rock	400
3.Sandy gravel and/or gravel (GW and GP)	200
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW,SP,SM,SC,GM,GC	150
5. Clay, sandy clay, silty clay, clayey silt (CL,ML, MH, and CH)	100

[1]For soil classifications OL, OH and PT (i.e., organic clays and peat), a foundation investigation shall be required.

[3] May be increased the amount of the designated value for each additional foot of depth to a maximum of 15 times the designated value. Isolated poles for uses such as flagpoles or signs and poles used to support buildings that are not adversely affected by a 1/2-inch motion at ground surface due to short-term lateral loads may be designed using lateral sliding resistance may be combined

$$\boxed{S1 := 150 \cdot \frac{(psf)}{ft}}$$

The value for S1 has to be multiplied by 2 since we allow for a 1/2" deflection at the surface. This number is also multiplied by 1/3 due to the depth of pilaster.

$$S1_{factored} := \frac{S1 \cdot 2}{3} \qquad S1_{factored} = 100 \cdot pcf$$

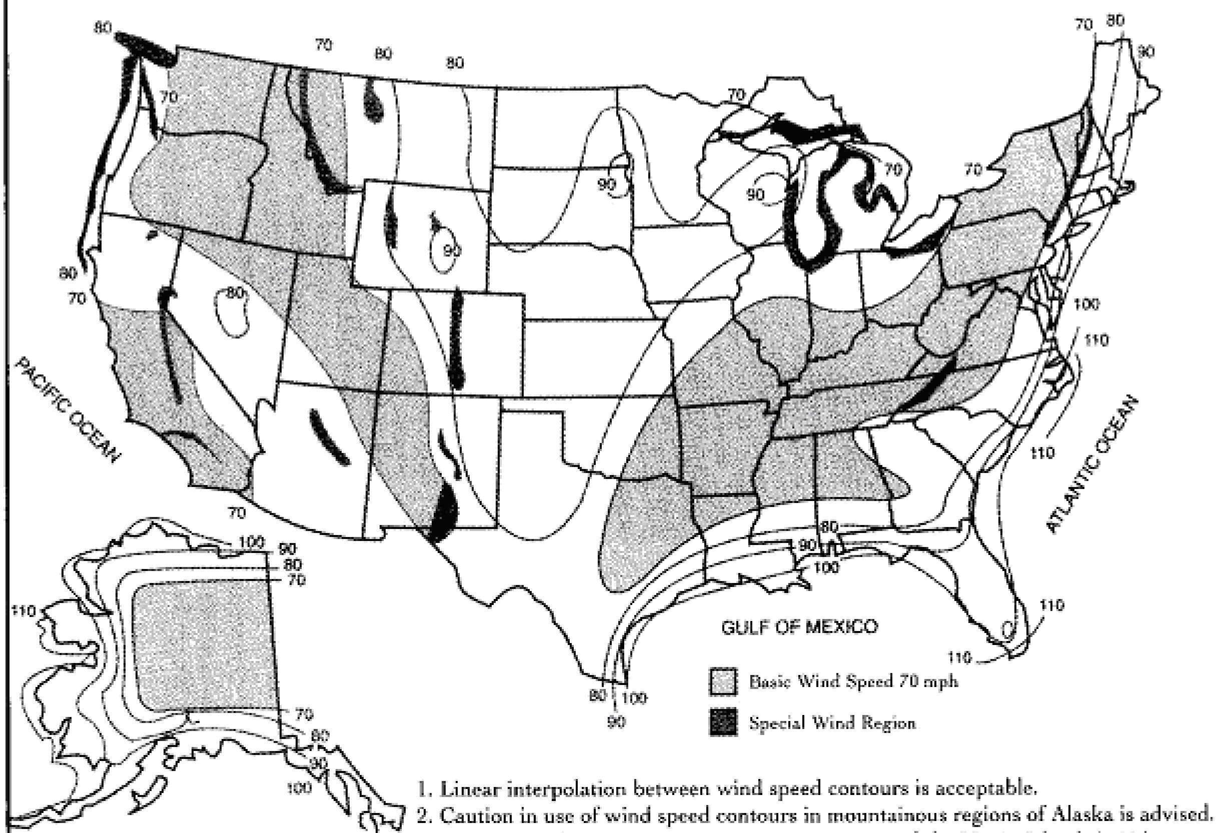
Concrete Parameters:

Compressive strength of concrete: $\boxed{fm := 3000 \cdot psi}$

The following tables are reproduced from the 1997 Uniform Building Code, Volume 2

Wind Pressure Conditions:

Figure 16-1 Minimum Basic Wind Speeds In Miles Per Hour (x 1.61 for km/h)



1. Linear interpolation between wind speed contours is acceptable.
2. Caution in use of wind speed contours in mountainous regions of Alaska is advised.
3. Wind speed for Hawaii is 80, Puerto Rico is 95 and the Virgin Islands is 110.
4. Wind speed may be assumed to be constant between the coastline and the nearest inland contour.

Basic Wind speed:

$\boxed{V := 80}$ Units := "mph"

UNITS:
mph = miles per hour
fps = feet per second

ConversionX := if(Units = "mph" , 0.00256psf, if(Units = "fps" , 0.00119psf, "CHECK UNITS"))

$\text{ConversionX} = 0.00256 \cdot \text{psf}$

Stagnation pressure:

$qs := \text{ConversionX}\, V^2$

$qs = 16.384 \cdot \text{psf}$

WIND EXPOSURE COEFFIECIENT

Exposure D - Describes the most severe exposure with surface roughness consisting of flat, unobstructed areas and bodies of water over 1 mile or more in width. Exposure D extends inland from the shoreline 1/4 mile.

Exposure C - Surface roughness consisting of open terrain with scattered obstructions having heights generally less than 30 ft extending 1/2 mile or more from the site. This category includes flat open country, grasslands, and bodies of water under 1-mile in width.

Exposure B - Surface roughness consisting of urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of a single family dwelling or larger.

Exposure type: $\boxed{Et := \text{"B"}}$

COMBINED HEIGHT, EXPOSURE AND GUST FACTOR COEFFICIENT (Ce)

Exposure	H<12 ft Pressure Coefficient	H>12 ft Pressure Coefficient
B	0.68	0.85
C	0.90	1.2
D	1.25	1.5

Wall Height: $H = 6.7111\,ft$

Combined height, exposure and gust factor coefficient: $Ce = 0.68$

Calculation for Wind Pressure (P):

$P := if(DWP > 0, DWP, Ce \cdot qs)$ PressureType = "Standard Method"

Calculated Wind Pressure (P): $P = 11.14 \cdot psf$

Pressure Entered by Engineer (DWP): $DWP = 0 \cdot psf$

Individual Block Weights (See Table):

Weights used for Estimating Self weight Resistance to Overturning:

Weight of post block: $Wpb = 70 \cdot lbf$

Weight of panel block: $Wpanb := 47 \cdot lbf$

Weight of cap block: $Wcb := 60 \cdot lbf$

Unit weight of concrete: $Wc := 135 \cdot pcf$

Block Type	Weight
Small Post	70lbf
Large Post	119lbf
Panel	47 lbf
Cap	60 lbf

Design Moments:

Design Moment for Post due to Wind (Figure 7):

$$M_{wind\_seis} := \frac{P \cdot s1 \cdot H^2}{2} \qquad M_{wind\_seis} = 3456.4 \cdot lbf \cdot ft$$

Design Moment for Panel (M_2)(Figure 8):

$$M_2 := \frac{P \cdot s1^2 \cdot H}{8 \cdot Nbb} \qquad M_2 = 886.91 \cdot lbf \cdot ft$$

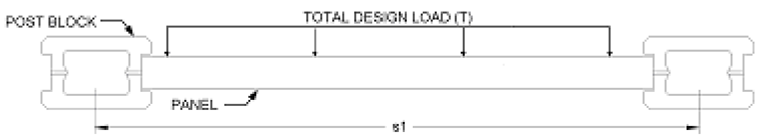


Figure 8: Panel Design Moment per Bond Beam

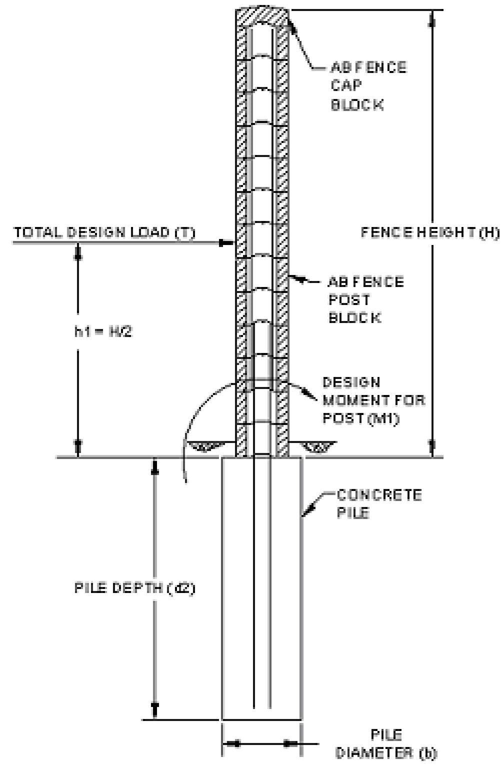


Figure 7: Post Moment

Calculation of Static Earth Pressure Coefficients

Wall Batter: $\beta := 90 \cdot deg$

Weighted Friction Angle: $\phi wi := \frac{2}{3} \cdot \phi i \qquad \phi wi = 20 \cdot deg$

Active earth pressure coefficient:

$$Ka := \left[\frac{\csc(\beta) \cdot \sin(\beta - \phi i)}{\sqrt{\sin(\beta + \phi wi)} + \sqrt{\left(\frac{\sin(\phi i + \phi wi) \cdot \sin(\phi i - i)}{\sin(\beta - i)} \right)}} \right]^2 \qquad Ka = 0.2973$$

Active Earth Force: $Fa := \frac{1}{2} \cdot Ka \cdot \gamma i \cdot Hs^2 \qquad Fa = 0 \cdot \frac{lbf}{ft} \qquad Fah := Fa \cdot \cos(\phi wi) \qquad Fah = 0 \cdot \frac{lbf}{ft}$

Surcharge Force: $Fq := q \cdot Ka \cdot Hs \qquad Fq = 0 \cdot \frac{lbf}{ft} \qquad Fqh := Fq \cdot \cos(\phi wi) \qquad Fqh = 0 \cdot \frac{lbf}{ft}$

Determine the Overturning Moments due to Soil Retention and Surcharge (Mah and Mqh):

$$Mah := Fah \cdot s1 \cdot \frac{Hs}{3} \qquad Mah = 0 \cdot lbf \cdot ft$$

$$Mqh := Fqh \cdot s1 \cdot 0.5 \cdot Hs \qquad Mqh = 0 \cdot lbf \cdot ft$$

Total Overturning Moment due to soil:

$$Msoil := Mah + Mqh \qquad Msoil = 0 \cdot lbf \cdot ft$$

Determine the Overturning Resistance due to Weight of Panel (Mpan):

Total Weight of Panel Block:

$Wpanelb := z \cdot Wpanb \cdot s$ $\qquad Wpanelb = 3995 \cdot lbf$

Total Weight of Grouted Cores: Number of Panel courses grouted: $Ncg := 2 \cdot Nbb$

$PanGrout := 7.22 lbf$ per core $\qquad Ncg = 4$

$Wgroutpan := Ncg \cdot PanGrout \cdot 2 \cdot s$ $\qquad Wgroutpan = 490.96 \cdot lbf$

Total Weight of Caps on Panel: $Wcap := Wcb \cdot s$ $\qquad Wcap = 510 \cdot lbf$

Total Panel Weight with cap: $Wpanel := Wpanelb + Wgroutpan + Wcap$ $\qquad Wpanel = 4995.96 \cdot lbf$

Total Resistance Moment due to Panel Weight: $Mpan := Wpanel \cdot \frac{t}{2}$ $\qquad Mpan = 1171.5526 \cdot lbf \cdot ft$

Estimated Footing Dimensions:

note: for actual footing depth see page 10.

Weight of Post, Cap and Footing:

Number of course tall: $PostH = 11$

$PostGrout = 48 \cdot lbf$

$Wpost := PostH \cdot (Wpb + PostGrout) + Wcb$ $\qquad Wpost = 1358 \cdot lbf$

$Wfooting := \pi \cdot \left(\frac{b}{2}\right)^2 \cdot d2 \cdot Wc$ $\qquad Wfooting = 1696.46 \cdot lbf$

Wc = unit weight of concrete- see page 4

Total Resistance Moment due to Post and Footing:

Note: To be conservative these calculations use half the width of the fence post for the moment arm of both post and footing.

$Mpost := Wpost \cdot \frac{Pd}{2}$ $\qquad Mpost = 657.815 \cdot lbf \cdot ft$

$Mfooting := Wfooting \cdot \frac{Pd}{2}$ $\qquad Mfooting = 821.7652 \cdot lbf \cdot ft$

Total Resistance Moment for Post Design:

$Mresist\_P := Mpan + Mpost$

$Mresist\_P = 1829.368 \cdot lbf \cdot ft$

Total Resistance Moment for Footing Design:

$Mresist\_F := Mpan + Mpost + Mfooting$

$Mresist\_F = 2651.1331 \cdot lbf \cdot ft$

Design Moment for Post Design

*Design includes soil retention and resistant moments from 90% of the self weight of the post and panel:

*A negative moment indicates that an engineer is to select a minimum required reinforcement.

$Mpostd := M_{wind\_seis} + Msoil - 0.9 Mresist\_P$

$Mpostd = 1809.9825 \cdot lbf \cdot ft$

Design Moment for Footing Design

*Design includes soil retention and resistant moments from 90% of the self weight of the post, panel and footing:

*A negative moment indicates that an engineer is to select a minimum required reinforcement.

$$Mftgd := M_{wind\_seis} + Msoil - 0.9Mresist\_F$$

$$Mftgd = 1070.3938 \cdot lbf \cdot ft$$

$$Mftgd := if(Mftgd < 0lbf \cdot ft, 0lbf \cdot ft, Mftgd)$$

$$Mftgd = 1070.3938 \cdot lbf \cdot ft$$

Determine the depth of the Footing Pilaster (d):

1806.8.2.1 1997 UBC

To calculate the required depth of a non-constrained pilaster the following equation is used:

P1 = The footing design moment translated to its force vector at the center height of the panel.

NOTE:
This Foundation Design section is used for both the UBC 97 and the self calculated wind pressure value.

$$P1 := \frac{Mftgd}{0.5 \cdot H} \qquad \text{depth} = \frac{A}{2} \cdot \left(1 + \sqrt{1 + \frac{4.36 \cdot h_1}{A}}\right)$$

$$A := \frac{2.34 \cdot P1}{S1_{factored} \cdot d2 \cdot b} \qquad A = 0.9331\,ft$$

h_1 = distance in feet from ground surface to point of application of T

$$h_1 := \frac{H}{2} \qquad h_1 = 3.3555\,ft$$

From the above equation the design footing depth can be determined.

$$d_1 := if\left[A = 0, \frac{A}{2}, \frac{A}{2} \cdot \left(1 + \sqrt{1 + \frac{4.36 \cdot h_1}{A}}\right)\right]$$

$$d_1 = 2.3719\,ft$$

By a system of iteration a value for the footing depth is determined.

$$\beta(d2, d_1) := if(d2 > d_1, d2, 0ft)$$

$$\beta(d2, d_1) = 4 \cdot ft \qquad d := \beta(d2, d_1)$$

Final value of footing depth

$$d = 4\,ft$$

$$Footing := if\left[d_1 = 0, \text{"Minimum Footing Depth per Engineer"}, (if(d = 0, \text{"NOT GOOD"}, \text{"OK"}))\right]$$

$$Footing = \text{"OK"}$$

If footing = "NOT GOOD" then you must assume a higher value for d2 or b

Calculated Moments

Designers Note One: Allan Block has preformed multiple flexural capacity tests Panel and Post Structures at the University of Calgary's research facilities and at Allan Block's own testing facility under the direct observation and certification of STORK Twin City Testing Corporation. These test results have clearly shown that the dry-stacked panel units flex under pressure and effectively dissipate applied forces. The reduction is through the theory of Work Energy. The applied forces stress the entire panel until the frictional interaction between the units is overcome at individual locations throughout the panel. This causes minor shifting of a joint location which releases the built-up internal pressures thus dissipating the applied force to the post structures. The following is a table of percentages of Design Force derived though testing and should be added to the post capacity formulas below.

TABLE 3

	Design Wind Speeds and Stagnation Pressures					
mph (kph)	70 (112)	80 (129)	90 (145)	100 (161)	110 (177)	120 (193)
Pressure lb/ft^2 (kPa)	9.45 (0.45)	12.3 (0.59)	15.6 (0.75)	19.2 (0.92)	23.25 (1.113)	27.68 (1.325)
	Percentage of Design Capacity Increase For Post Design					
Per (%)	1.50	1.45	1.35	1.30	1.20	1.10

Percent Value = $\boxed{Per := 1.45}$

Designers Note Two: Results from the above mentioned testing also warrants an increase of capacity of the bond beam structure. Simple beam theory to calculate the capacity of the bond beams does not allow for the added flexural stiffness the ball and socket joint configuration brings to the bond beam. The added strength comes from the interlocking of the joint due to the systems self weight which inherently resists bending. In order for the ball and socket joint to flex, the frictional interaction within the joint caused by the natural self weight of the system must be overcome. In the above mentioned testing the bond beams and dry-stacked units were tested in combination to pressure levels well exceeding the calculated capacity and therefore, these calculations use a conservative increase of 50% to account for the additional flexural resistance the dry-stacked units bring to the flexural system of the panel. See the Bond Beam Sections below.

Compressive Stress Calculations

Compressive stress in masonry

$fm = 3000 \cdot psi$

*fm is the uniaxial compressive strength of concrete.

$f_b := \frac{1}{3} \cdot fm \qquad f_b = 1000 \cdot psi$

The moment at the service load for panel (Mp):

Area of Steel in post per bar:

$A_b := 3.1416 \cdot r^2$

$A_b = 0.196 \cdot in^2$

Post section length:

$bs := Pl - 2Pnd$

$bs = 1.2188\,ft$

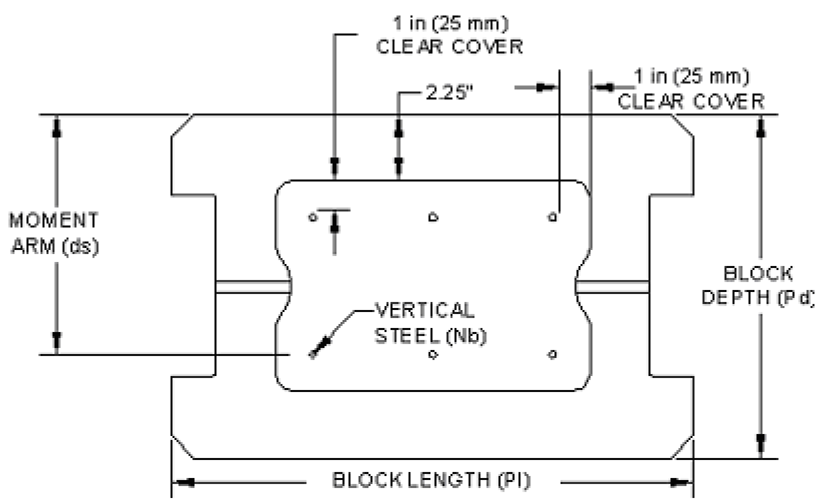


Figure 9: Vertical Steel Placement

Post section width:

$ds := Pd - 2.25 \cdot in - 1 \cdot in - r$

$ds = 0.6771\,ft$

Total Area of Steel per post:

$A_s := A_b \cdot Nb$

$A_s = 0.785 \cdot in^2$

Ratio of steel area per post area:

$q := \dfrac{A_s}{2 \cdot bs \cdot ds}$ $q = 0.0033$

E_s is the modulus of elasticity for all non prestressed steel, this value is taken as 29,000,000 psi from UBC 2106.2.12.2

$E_s := 29000ksi$

E_m is modulus of elasticity of masonry. This value is taken as 750*f'm from UBC 2106.2.12.1

$E_m := 750 \cdot fm$ $E_m = 2250 \cdot ksi$

n is the modular ratio

$n := \dfrac{E_s}{E_m}$ $n = 12.889$

k and j are coefficients used for internal moments and definition of neutral axis.

To solve for these variables we equate the first moments about the neutral axis of the masonry and steel areas

$k := \sqrt{(n \cdot q)^2 + 2 \cdot n \cdot q} - n \cdot q$ $k = 0.2524$

$j := 1 - \dfrac{k}{3}$ $j = 0.9159$

Moment Capacity based on Compressive Stress in Pilaster (Mp):

$M_p := \dfrac{Per \cdot f_b \cdot bs \cdot ds^2 \cdot j \cdot k}{2}$ $M_p = 13484.5 \cdot lbf \cdot ft$

$Mpostd = 1809.9825 \cdot lbf \cdot ft$

CompStressPil := if(Mpostd < 0 · lbf·ft, "Minimum Reinforcement per Engineer" , if(M_p > Mpostd, "OK" , "NOT GOOD"))

CompStressPil = "OK"

If Mp is greater than M_1 then design is "OK". If not, more steel reinforcement is needed in the pilaster or reduce the tributary area.

Moment Capacity based on Compressive Stress in Bond Beam (Mbb):

Area of steel in bond beam per bar:

$A_{bb} := 3.1416 \cdot rbb^2$ $A_{bb} = 0.196 \cdot in^2$

Bond beam section height: $b_p := 2 \cdot h$ $b_p = 1.2708\,ft$

Bond beam section width: $d_p := 0.5 \cdot t$ $d_p = 2.814 \cdot in$

Ratio of steel area per bond beam area:

Note: Bond Beam Test results have consistently shown much higher moment capacities. This is due to the ball and socket configuration of the panel block and the flange effect of the glued in place cap block. Thus the 1.5 multiplier on Mbb.

$q_{bb} := \frac{A_{bb}}{b_p \cdot d_p}$ $\qquad q_{bb} = 0.004576$

$k_{bb} := \sqrt{(n \cdot q_{bb})^2 + 2 \cdot n \cdot q_{bb}} - n \cdot q_{bb}$ $\qquad k_{bb} = 0.2895$

$j_{bb} := 1 - \frac{k_{bb}}{3}$ $\qquad j_{bb} = 0.9035$

$M_{bb} := \frac{1.5 \cdot f_b \cdot \left(b_p \cdot d_p^{\,2}\right) \cdot j_{bb} \cdot k_{bb}}{2}$ $\qquad M_{bb} = 1974.0076 \cdot lbf \cdot ft$

$M_2 = 886.91 \cdot lbf \cdot ft$ $\qquad$ CompStressBB := if($M_2 < M_{bb}$, "OK" , "NOT GOOD")

CompStressBB = "OK"

If M_{bb} is greater than M_2 then design is "OK". If not, the tributary area must be reduced or add additional Bond Beams.

Tensile Stress Calculations

Moment Capacity based on Tensile Stress in Pilaster (Mcp):

$f_y := 60ksi$

$f_s := 0.4 \cdot f_y$ $\qquad f_s = 24 \cdot ksi$

$M_{cp} := Per \cdot f_s \cdot \frac{A_s}{2} \cdot j \cdot ds$ $\qquad M_{cp} = 8475.3 \cdot lbf \cdot ft$

Mpostd = 1809.98·lbf·ft

TenStressPil := if(Mpostd < 0, "Minimum Reinforcement per Engineer" , if(Mpostd < M_{cp}, "OK" , "NOT GOOD"))

TenStressPil = "OK"

If M_{cp} is greater than M_1 then design is "OK". If not, more steel reinforcement is needed in the pilaster or reduce the tributary area.

Moment Capacity based on Tensile Stress in Bond Beam (Mcbb):

Note: Bond Beam Test results have consistently shown much higher moment capacities. This is due to the ball and socket configuration of the panel block and the flange effect of the glued in place cap block. Thus the 1.5 multiplier on Mcbb.

$M_{cbb} := 1.5 \cdot f_s \cdot A_{bb} \cdot j_{bb} \cdot d_p$ $\qquad M_{cbb} = 1497.6 \cdot lbf \cdot ft$

$M_2 = 886.9138\ ft \cdot lbf$ $\qquad$ TenStressBB := if($M_2 < M_{cbb}$, "OK" , "NOT GOOD")

TenStressBB = "OK"

If Mcbb is greater than M_2 then design is "OK". If not, the tributary area must be reduced or add additional Bond Beams.

Concrete Shear Calculations

Allowable shear stress for reinforced masonry is

$S_{ssa} := 55psi$

Calculated shear stress at the base of pilaster

$S_{req} := \frac{P \cdot Ta}{bs \cdot ds}$

$S_{req} = 8.6675 \cdot psi$

$ShearPil := if(S_{ssa} > S_{req}, "OK", "NOT GOOD")$

$ShearPil = "OK"$

If S is greater than S then design is "OK". If not, more steel reinforcement is needed at the pile.

Allowable Wing Shear:

Note: The allowable wing shear is based on the available area of the wing, laboratory shear test results of pile blocks (270 psi) and a factor of safety of 3. Where Aw is the thickness of the post wing.

$A_w := 2.75in$

$S_{wing} := \frac{270psi \cdot A_w}{3}$

$S_{wing} = 2970 \cdot \frac{lbf}{ft}$

The calculated shear is as follows:

$A_{wpanel} := H \cdot (s1 - 1.4687ft)$

$S_{wreq} := \frac{0.5 \cdot P \cdot A_{wpanel}}{H}$

$S_{wreq} = 69 \cdot \frac{lbf}{ft}$

$ShearWing := if(S_{wing} > S_{wreq}, "OK", "NOT GOOD")$

$ShearWing = "OK"$

If S_{wing} is greater than S_{wreq} then design is OK. If not, AB Fence is not adequate for this project.

Summary:

Allan Block Parameters:

Block height: $h = 0.635\,ft$

Panel Block depth: $t = 0.469\,ft$

Panel Block length: $w = 1.4688\,ft$

Post Block length: $Pl = 1.4688\,ft$

Post Block depth: $Pd = 0.9688\,ft$

Post Block Notch depth: $Pnd = 0.125\,ft$

Concrete Parameters:

Compressive strength of concrete: $fm = 3000 \cdot psi$

Wind Pressure Conditions: (UBC 97)

Basic Wind speed: $V = 80$ Units = "mph"

Stagnation pressure: $qs = 16.384 \cdot psf$

Exposure type: Et = "B"

Combined height, exposure and gust factor coefficient: $Ce = 0.68$

Fence Parameters:

Number of Panel Courses: $z = 10$

Number of Post Courses: $PostH = 11$

Panel Height: $H = 6.7111\,ft$

Post Height: $PH = 7.3852\,ft$

Number of full size block per panel to determine length: $s = 8.5$

Post Spacing

Center of Post Block to Center of Post block (used for design): $s1 = 13.777\,ft$

Post Spacing for dimensioning ONLY:

Center of Post Block to Center of Corner block:

$$s_2 := s \cdot w + \frac{(Pl + Pc)}{2} - 2.5in$$

$s_2 = 13.5109\,ft$

Center of Corner Block to Center of Corner Block

$$s_3 := s \cdot w + Pc - 2.5in$$

$s_3 = 13.2765\,ft$

Wind Pressure Calculated:

$DWP = 0 \cdot psf$

Steel Parameters:

Post

Number of rebar in post: $Nb = 4$

Post bar size (radius): $r = 0.0208\,ft$

Post bar number: $size = 4$

Bond Beam

Number of bond beams: $Nbb = 2$

Bond beam bar size (radius); $rbb = 0.0208\,ft$

Bond beam bar number: $sizebb = 4$

Footing Dimensions:

footing depth: $d2 = 4\,ft$

footing diameter: $b = 2\,ft$

Footing = "OK"

Summary (cont.):

Design Moment:

Post: $Mpostd = 1809.9825 \cdot lbf \cdot ft$

Footing: $Mftgd = 1070.3938 \cdot lbf \cdot ft$

Panel: $M_2 = 886.9138 \cdot lbf \cdot ft$

Total moment not reduced by self weight: $M_{wind\_seis} = 3456.4135 \cdot lbf \cdot ft$

Compressive Stress:

Post/Pilaster: $M_p = 13484.5373 \cdot lbf \cdot ft$

CompStressPil = "OK"

Bond Beam: $M_{bb} = 1974.0076 \cdot lbf \cdot ft$

CompStressBB = "OK"

Tensile Stress in Rebar:

Post/Pilaster: $M_{cp} = 8475.2664 \cdot lbf \cdot ft$

TenStressPil = "OK"

Bond Beam: $M_{cbb} = 1497.6356 \cdot lbf \cdot ft$

TenStressBB = "OK"

Shear of Masonry and Concrete:

Allowable shear stress for reinforced masonry: $S_{ssa} = 7920 \cdot psf$

Calculated shear stress at the base of the pilaster: $S_{req} = 1248.1171 \cdot psf$

ShearPil = "OK"

Allowable wing shear: $S_{wing} = 2970 \cdot \frac{lbf}{ft}$

ShearWing = "OK"

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Version 12.5

AB Estimate Worksheet

Project Name:	Ocean Township High School
Project Number:	074.05
Project Location:	Ocean Township, NJ
Date:	5/29/12
Prepared By:	ESR

Design Parameters

Fence Number: 1

Section	Fence Height* (Courses)	Post Height* (Block)	Post Spacing* (Block)	Total Length* (ft)	Corners	Bond Beams per Panel	# of Post Rebar	Size of Post Rebar	Post Size	Pile Diameter	Pile Depth
0	6.8 ft (10)	7.4 ft (11)	13.7 ft (8.5)	13.7 ft	0	2	4	#4	Std	2 ft	4 ft

Total Fence Length*: 15 ft

Material Estimate

Material	Quantity	Unit	Overage %	Total Quantity	Cost	Total Cost
AB Fence Panel Block	80	Block	0	80	0	0
AB Fence Half Panel Block	10	Block	0	10	0	0
AB Fence Post Block	22	Block	0	22	0	0
AB Fence Cap	11	Caps	0	11	0	0
Base Rock	0.3	yd^3	0	0.3	0	0
Round Concrete Forms	2	ft	0	2	0	0
Cap Adhesive	0.5	Tubes	0	1	0	0
Pile Concrete	0.9	yd^3	0	0.9	0	0
Post Grout	0.3	yd^3	0	0.3	0	0
Sand Mix Grout for Bond Beams	0.2	yd^3	0	0.2	0	0
#4 Rebar	128.9	ft	0	128.9	0	0
9 ga Wire for Stirrups	28.9	ft	0	28.9	0	0

Labor and Engineering Estimate

Item	Quantity	Productivity	Cost	Total Cost
Layout Crew	13.7 ft	0 ft/hr	0	0
Pile Crew	2 Piles	0 Piles/hr	0	0
Base Crew	13.7 ft	0 ft/hr	0	0
Fence Crew	91.1 ft^2	0 ft^2/hr	0	0
Engineering	99.9 ft^2		0 /ft^2	0

Estimate Summary

Material Cost:	0
Engineering / Labor Cost:	0
Overhead:	0 %
Profit:	0 %
Total Cost:	**0**
Cost / ft^2:	0

Fence Information

Standard Pattern

Standard Bond Beams

***ALL DIMENSIONS ARE APPROXIMATE - DO NOT USE THE NOTED POST SPACING FOR FENCE LAYOUT.**