

## Appendix A Shear Wall Design

Shear Wall Forces (With Expansion Joint After Adding Required Walls)								
Wall #	Story	V (k)	M (ft-k)		Wall #	Story	V (k)	M (ft-k)
↓	1 ROOF	4.89	88.042		↓	6 ROOF	13.48	1.1233333
	EIGHTH STORY	35.96	543.566			EIGHTH FLOOR	61.65	5.1375
	SEVENTH STORY	61.63	1324.201			SEVENTH FLOOR	154.16	12.846667
	SIXTH STORY	83.58	2271.43			SIXTH FLOOR	225.76	18.813333
	FIFTH STORY	100.69	3412.537			FIFTH FLOOR	282.5	23.541667
	FOURTH STORY	114	4704.484			FOURTH FLOOR	326.05	27.170833
	THIRD STORY	121.38	6080.153			THIRD FLOOR	372.68	31.056667
	SECOND STORY	136.72	8176.503			SECOND FLOOR	410.05	34.170833
	FIRST FLOOR	126.15	9942.546			FIRST FLOOR	443.25	36.9375
↓	2 ROOF	9.16	164.894		↓	7 ROOF	3.08	0.2566667
	EIGHTH STORY	59.32	709.516			EIGHTH FLOOR	7.7	0.6416667
	SEVENTH STORY	107.9	2076.223			SEVENTH FLOOR	13.88	1.1566667
	SIXTH STORY	157.71	3863.623			SIXTH FLOOR	16.64	1.3866667
	FIFTH STORY	178.1	5882.127			FIFTH FLOOR	20.9	1.7416667
	FOURTH STORY	241.12	8614.811			FOURTH FLOOR	17.62	1.4683333
	THIRD STORY	291.28	11915.989			THIRD FLOOR	42.8	3.5666667
	SECOND STORY	339.24	17117.619			SECOND FLOOR	-25.56	-2.13
	FIRST FLOOR	387.54	22543.137			FIRST FLOOR	129.4	10.783333
↓	3 ROOF	11.52	207.421		↓	8 ROOF	16.02	1.335
	EIGHTH STORY	15.48	403.533			EIGHTH FLOOR	60.98	5.0816667
	SEVENTH STORY	19.58	651.525			SEVENTH FLOOR	153.17	12.764167
	SIXTH STORY	20.91	888.562			SIXTH FLOOR	224.55	18.7125
	FIFTH STORY	22.86	1147.663			FIFTH FLOOR	281.15	23.429167
	FOURTH STORY	57.96	1804.491			FOURTH FLOOR	324.51	27.0425
	THIRD STORY	87.79	2799.427			THIRD FLOOR	371.04	30.92
	SECOND STORY	110.61	4495.478			SECOND FLOOR	408.85	34.070833
	FIRST FLOOR	113.74	6087.877			FIRST FLOOR	439.8	36.65
↓	4 ROOF	12.05	1.0041667		↓	9 ROOF	227.76	18.98
	EIGHTH FLOOR	133.3	11.108333			EIGHTH FLOOR	384.96	32.08
	SEVENTH FLOOR	290.38	24.198333			SEVENTH FLOOR	581.3	48.441667
	SIXTH FLOOR	417.85	34.820833			SIXTH FLOOR	745.39	62.115833
	FIFTH FLOOR	519.07	43.255833			FIFTH FLOOR	880.76	73.396667
	FOURTH FLOOR	598.77	49.8975			FOURTH FLOOR	1005.96	83.83
	THIRD FLOOR	676.56	56.38			THIRD FLOOR	1149.6	95.8
	SECOND FLOOR	717.94	59.828333			SECOND FLOOR	1353.12	112.76
	FIRST FLOOR	676.39	56.365833			FIRST FLOOR	823.48	68.623333
↓	5 ROOF	-6.34	-0.528333		↓	10 ROOF	49.57	4.1308333
	EIGHTH FLOOR	54.81	4.5675			EIGHTH FLOOR	97.5	8.125
	SEVENTH FLOOR	136.25	11.354167			SEVENTH FLOOR	160.24	13.353333
	SIXTH FLOOR	197.95	16.495833			SIXTH FLOOR	160.24	13.353333
	FIFTH FLOOR	246.57	20.5475			FIFTH FLOOR	160.24	13.353333
	FOURTH FLOOR	284.17	23.680833			FOURTH FLOOR	255.84	21.32
	THIRD FLOOR	324.57	27.0475			THIRD FLOOR	245.59	20.465833
	SECOND FLOOR	353.15	29.429167			SECOND FLOOR	435.8	36.316667
	FIRST FLOOR	424.75	35.395833			FIRST FLOOR	435.8	36.316667

Shear Wall Forces (With Expansion Joint After Adding Required Walls)								
Wall #	Story	V (k)	M (ft-k)		Wall #	Story	V (k)	M (ft-k)
11	ROOF	119.39	9.949167	↓	15	ROOF	8.5	153.026
	EIGHTH FLOOR	181.5	15.125			EIGHTH STORY	10.87	290.756
	SEVENTH FLOOR	271.17	22.5975			SEVENTH STORY	13.53	462.088
	SIXTH FLOOR	344.35	28.69583			SIXTH STORY	14.03	621.061
	FIFTH FLOOR	399.47	33.28917			FIFTH STORY	13.8	777.498
	FOURTH FLOOR	430.97	35.91417			FOURTH STORY	41.45	1247.234
	THIRD FLOOR	439.81	36.65083			THIRD STORY	64.24	1975.336
	SECOND FLOOR	429.53	35.79417			SECOND STORY	79.16	3189.1
12	FIRST FLOOR	407.37	33.9475	↓	16	FIRST FLOOR	92.19	4479.733
	ROOF	57.71	4.809167			ROOF	3.12	56.158
	EIGHTH FLOOR	113.94	9.495			EIGHTH STORY	26.05	56.158
	SEVENTH FLOOR	184.94	15.41167			SEVENTH STORY	44.22	386.133
	SIXTH FLOOR	237.68	19.80667			SIXTH STORY	59.9	946.307
	FIFTH FLOOR	276.52	23.04333			FIFTH STORY	72.07	1625.211
	FOURTH FLOOR	306.17	25.51417			FOURTH STORY	82.2	2442.044
	THIRD FLOOR	290.58	24.215			THIRD STORY	90.94	3373.646
13	SECOND FLOOR	276.93	23.0775	↓	17	SECOND STORY	93.09	4404.259
	FIRST FLOOR	497.58	41.465			FIRST FLOOR	109.65	5831.622
	ROOF	58.26	4.855			ROOF	-31.25	-472.522
	EIGHTH FLOOR	109.09	9.090833			EIGHTH STORY	-54.63	-863.06
	SEVENTH FLOOR	178.14	14.845			SEVENTH STORY	-74.06	-1256.55
	SIXTH FLOOR	238.08	19.84			SIXTH STORY	-82.04	-1491.19
	FIFTH FLOOR	285.55	23.79583			FIFTH STORY	-107.3	-1859.8
	FOURTH FLOOR	318.2	26.51667			FOURTH STORY	-132.9	-2296.84
14	THIRD FLOOR	339.2	28.26667	↓	18	THIRD STORY	-153.8	-2800.75
	SECOND FLOOR	309.16	25.76333			SECOND STORY	-161.1	-3555.13
	FIRST FLOOR	268.36	22.36333			FIRST FLOOR	-160.9	-3677.9
	ROOF	-90.81	-7.5675			ROOF	-1.11	39.706
	EIGHTH FLOOR	77.04	6.42			EIGHTH STORY	25.76	255.609
	SEVENTH FLOOR	143.39	11.94917			SEVENTH STORY	44.1	677.067
	SIXTH FLOOR	196.43	16.36917			SIXTH STORY	61.4	1187.429
	FIFTH FLOOR	239.02	19.91833			FIFTH STORY	77.8	1835.307
14	FOURTH FLOOR	267.47	22.28917	↓	18	FOURTH STORY	80.38	2451.4
	THIRD FLOOR	287.89	23.99083			THIRD STORY	80.72	3015.326
	SECOND FLOOR	302.01	25.1675			SECOND STORY	89.53	3907.391
	FIRST FLOOR	342.37	28.53083			FIRST FLOOR	93.02	4605.752

<b>Shear Wall Forces (Post-Tensioned Conference Wing)</b>			
Wall #	Story	V (k)	M (ft-k)
19	SECOND STORY	30.7	552.57
↓	FIRST FLOOR	105.9	2035.153
20	THIRD STORY	36.34	401.063
↓	SECOND STORY	81.17	1383.472
↓	FIRST FLOOR	133.52	2457.171
21	THIRD STORY	86.49	673.003
↓	SECOND STORY	134.03	1485.795
↓	FIRST FLOOR	150.91	1780.027
22	THIRD STORY	-64.42	-522.838
↓	SECOND STORY	-76.77	-1354.448
↓	FIRST FLOOR	-132.26	-2492.499
23	THIRD STORY	51.46	536.867
↓	SECOND STORY	127.4	2046.526
↓	FIRST FLOOR	187.63	3618.693
24	THIRD STORY	15.01	113.387
↓	SECOND STORY	32.8	306.455
↓	FIRST FLOOR	53.76	673.614
25	THIRD STORY	91.48	1311.237
↓	SECOND STORY	170.72	4384.221
↓	FIRST FLOOR	229.98	7603.877
26	THIRD STORY	105.41	1510.87
↓	SECOND STORY	177.75	4710.306
↓	FIRST FLOOR	241.47	8090.857
27	THIRD STORY	138.88	1990.617
↓	SECOND STORY	227.89	6092.708
↓	FIRST FLOOR	348.38	10969.995

12" Concrete Shear Wall Schedule								
Floor	1	2	3	4	5	6	7	8
Length	11.7	18.5	11.7	23.5	18.58	19.7	8.75	19.7
Boundary Element	T.1-59, T.1-61	T.1-59, U.1-59	U.1-59,U.1-61	U.66	U-69	U-71	U-71, U-72	T-72
8	#5@18"	#5@18"	#5@18"		#5@18"	#5@18"	#5@18"	#5@18"
7	↓	↓	↓	#5@18"	↓	↓	↓	↓
6				↓				
5								
4								
3								
2				#5@16"				
1				↓				
G								

12" Concrete Shear Wall Schedule								
Floor	9	10	11	12	13	14	15	16
Length	26.2	18.5	20.67	18.5	9	20.67	11.4	11.4
Boundary Element	S-72	Q-71	N-71	R-71	N-71, M-71	M-71	U.1-63, U.1-65	T.1-63, T.1-65
8			#5@18"	#5@18"	#5@18"	#5@18"	#5@18"	#5@18"
7	#5@14"	#5@18"	↓	↓	↓	↓	↓	↓
6	↓							
5								
4	#5@10"							
3	↓							
2	#5@16"							
1	↓							
G								

12" Concrete Shear Wall Schedule						
Wall #	17	18	19	20	21	22
Length	17.5	9.25	20.67	19.75	12.2	19.75
Boundary Element	R.2-59, S-59	S-59, S-61	-	-	-	-
8	#5@18"	#5@18"				
7	↓	↓				
6						
5						
4						
3						
2				#5@18"	#5@18"	#5@18"
1			#5@18"	↓	↓	↓
G	↓	↓	↓	↓	↓	↓

12" Concrete Shear Wall Schedule					
Wall #	23	24	25	26	27
Length	18.25	9.67	28	28	28
Boundary Element	-	-	-	-	-
8					
7					
6					
5					
4					
3					
2	#5@18"	#5@18"	#5@18"	#5@18"	#5@18"
1	↓	↓	↓	↓	↓
G	↓	↓	↓	↓	↓

The above schedules give the length, reinforcement, and boundary element locations for all shear walls. To view the reinforcement designed for the shear wall boundary elements see the column schedules in Appendix C.

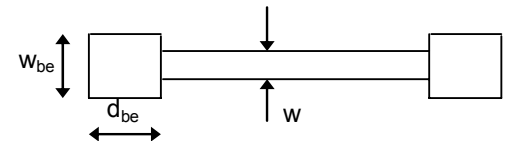
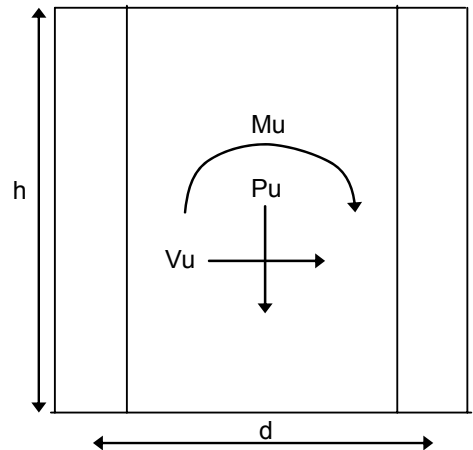
## Shear Wall Design

Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	1 - Ground Floor through 2nd

Material Properties	
Concrete Strength - $f'_c$ (psi) =	5000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	11.7
Width - $w$ (in) =	16
Height - $h$ (ft) =	118

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	18
Width - $w_{be}$ (in) =	18



Wall Loads	
$P_u$ (kip) =	813
$M_u$ (ft-kip) =	9943
$V_u$ (kip) =	126

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1256.329

ACI 21.7.6.3

Boundary Element Check	
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$A_g$  (ft<sup>2</sup>) = 17.6  
 $I_g$  (in<sup>4</sup>) = 255.552  
 Extreme Fiber Comp. -  $F_c$  (ksi) = 2.104066

Boundary Element Needed -  $f_c > 0.2 f'_c$

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$A_{cv} \text{ (in}^2\text{/ft)} = 192$

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$A_{s_{req'd}} \text{ (in}^2\text{/ft)} = 0.48$

$A_{s_{supplied}} \text{ (in}^2\text{)} = 0.62$  #5 Bars

Bar Diameter (in) = 0.625

Required Spacing -  $S_{req'd}$  (in) = 15.5 **OK**

Spacing Supplied -  $S_{supplied}$  (in) = 15

**Shear Capacity Check**

$\alpha_c = h_w/l_w = 2$  **hw/lw > 2 therefore use 2**

$A_{cv_{total}} \text{ (in}^2\text{)} = 2534.4$

Transverse -  $\rho_t = 0.002583$

Nominal Shear Capacity -  $V_n$  (kip) = 751.2503

Shear Capacity -  $\Phi V_n$  (kip) = 450.7502 **OK**

**Boundary Element Capacity Check**

$A_{st} \text{ (in}^2\text{)} = 18.72$  12-#11

$\rho_{st} = 0.057778$  **OK**

$P_n(\text{max})$  (kip) = 1936.512

Axial Load Capacity -  $\Phi P_n$  (kip) = 1355.558 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max}$  (in) = 4

Vert. Spacing Supplied -  $S_{supplied}$  (in) = 4

Short Direction (in) = 18

Long Direction (in) = 18

Bar Diameter (in) = 0.625 #5 Bar

Cover from center of Vert. Reinf. To Col. Face (in) = 3

$A_s$  of one Bar (in<sup>2</sup>) = 0.31

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 192.5156

**Short Direction**

Number of Crossties In Short Derection = 4

$h_c$  (in) = 13.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.904949

$A_s$  provided (in<sup>2</sup>) = 1.24 **OK**

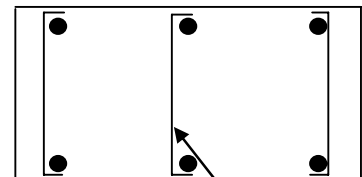
**Long Direction**

Number of Crossties In Short Derection = 4

$h_c$  (in) = 13.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.904949

$A_s$  provided (in<sup>2</sup>) = 1.24 **OK**

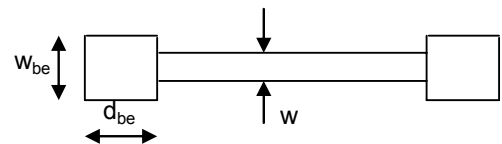
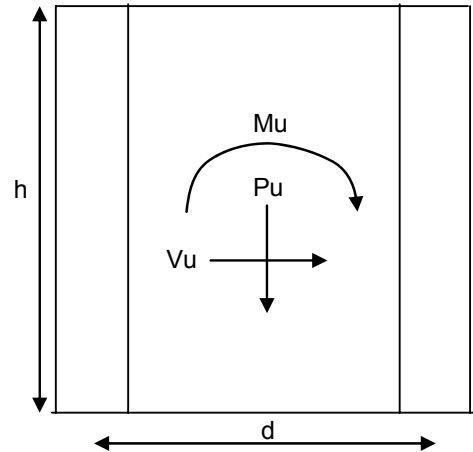


Shear Wall Design	
Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	1 - 3rd through 8th

Material Properties	
Concrete Strength - $f'_c$ (psi) =	4000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	11.7
Width - $w$ (in) =	12
Height - $h$ (ft) =	118

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	18
Width - $w_{be}$ (in) =	18



Wall Loads	
$P_u$ (kip) =	586
$M_u$ (ft-kip) =	4704
$V_u$ (kip) =	114

Boundary Element	
Axial Force - $P_{U_{be}}$ (kip) =	695.0513

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	13.2
$I_g$ (in <sup>4</sup> ) =	191.664
Extreme Fiber Comp. - $F_c$ (ksi) =	1.433176

**Boundary Element Needed -  $f_c > 0.2 f'_c$**



ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

Acv (in<sup>2</sup>/ft) = 144  
 Longitudinal - ρ<sub>l</sub>, Transverse - ρ<sub>t</sub> >= 0.0025  
 As<sub>req'd</sub> (in<sup>2</sup>/ft) = 0.36

As <sub>supplied</sub> (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing - S<sub>req'd</sub> (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - S <sub>supplied</sub> (in) =	18
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**Shear Capacity Check**

α<sub>c</sub> = h<sub>w</sub>/l<sub>w</sub> = 2 **hw/lw>2 therefore use 2**  
 Acv<sub>total</sub> (in<sup>2</sup>) = 1900.8  
 Transverse - ρ<sub>t</sub> = 0.00287  
 Nominal Shear Capacity - V<sub>n</sub> (kip) = 567.7943  
 Shear Capacity - ΦV<sub>n</sub> (kip) = 340.6766 **OK**

**Boundary Element Capacity Check**

A <sub>st</sub> (in <sup>2</sup> ) =	6.24	4-#11
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ρ<sub>st</sub> = 0.019259 **OK**  
 P<sub>n</sub>(max) (kip) = 1163.827  
 Axial Load Capacity - ΦP<sub>n</sub> (kip) = 814.679 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing - S <sub>max</sub> (in) =	4	
Vert. Spacing Supplied - S <sub>supplied</sub> (in) =	4	
Short Direction (in) =	18	
Long Direction (in) =	18	
Bar Diameter (in) =	0.625	#5 Bar
Cover from center of Vert. Reinf. To Col. Face (in) =	3	
As of one Bar (in <sup>2</sup> ) =	0.31	

Area Bounded by out-to-out of hoops - A<sub>ch</sub> (in<sup>2</sup>) = 192.5156

**Short Direction**

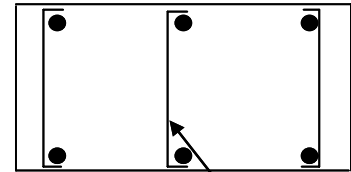
Number of Crossties In Short Direction =	3
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hc (in) = 13.25  
 Req'd Reinf. In Short Direction - A<sub>sh</sub> (in<sup>2</sup>) = 0.723959  
 As provided (in<sup>2</sup>) = 0.93 **OK**

**Long Direction**

Number of Crossties In Short Direction =	3
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hc (in) = 13.25  
 Req'd Reinf. In Short Direction - A<sub>sh</sub> (in<sup>2</sup>) = 0.723959  
 As provided (in<sup>2</sup>) = 0.93 **OK**



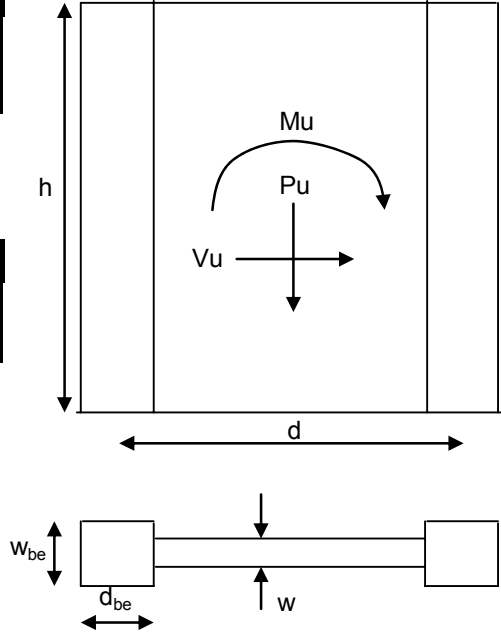
## Shear Wall Design

Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	5 - Ground Floor through 2nd

Material Properties	
Concrete Strength - $f'_c$ (psi) =	5000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	18.58
Width - $w$ (in) =	12
Height - $h$ (ft) =	118

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	30
Width - $w_{be}$ (in) =	30



Wall Loads	
$P_u$ (kip) =	2253
$M_u$ (ft-kip) =	25605
$V_u$ (kip) =	425

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	2504.595

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	21.08
$I_g$ (in <sup>4</sup> ) =	780.6036
Extreme Fiber Comp. - $F_c$ (ksi) =	3.143103

Boundary Element Needed -  $f_c > 0.2 f'_c$

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144  
 Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$   
 $As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	18
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**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**  
 $Ac_{v_{total}}$  (in<sup>2</sup>) = 3035.52  
 Transverse -  $\rho_t$  = 0.00287  
 Nominal Shear Capacity -  $V_n$  (kip) = 952.0714  
 Shear Capacity -  $\phi V_n$  (kip) = 571.2428 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	12.48	8-#11
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$\rho_{st}$  = 0.013867 **OK**  
 $P_n$ (max) (kip) = 3616.608  
 Axial Load Capacity -  $\phi P_n$  (kip) = 2531.626 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing - $S_{max}$ (in) =	4	
Vert. Spacing Supplied - $S_{supplied}$ (in) =	4	
Short Direction (in) =	30	
Long Direction (in) =	30	
Bar Diameter (in) =	0.625	#5 Bar
Cover from center of Vert. Reinf. To Col. Face (in) =	3	
As of one Bar (in <sup>2</sup> ) =	0.31	

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 669.5156

**Short Direction**

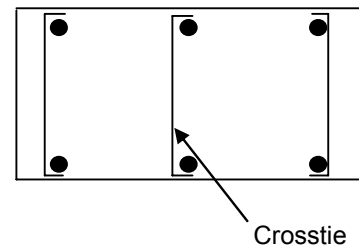
Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 25.25  
 Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.869245  
 As provided (in<sup>2</sup>) = 0.93 **OK**

**Long Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 25.25  
 Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.869245  
 As provided (in<sup>2</sup>) = 0.93 **OK**

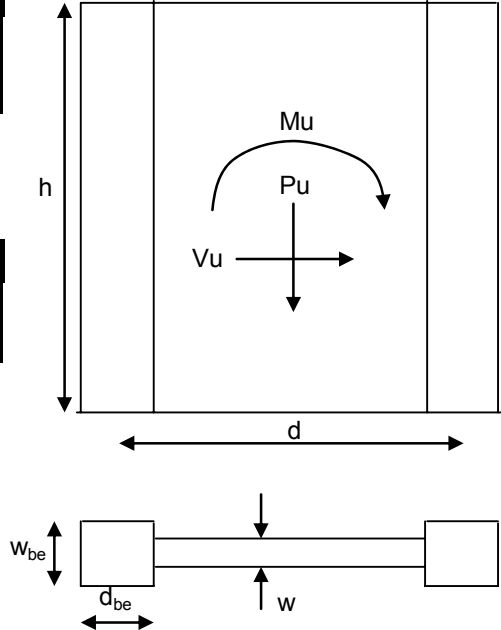


Shear Wall Design	
Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	5 - 3rd and 4th Floors

Material Properties	
Concrete Strength - $f'_c$ (psi) =	4000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	18.58
Width - $w$ (in) =	12
Height - $h$ (ft) =	77.33

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	24



Wall Loads	
$P_u$ (kip) =	1522
$M_u$ (ft-kip) =	10564
$V_u$ (kip) =	284

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1329.568

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	20.58
$I_g$ (in <sup>4</sup> ) =	726.3649
Extreme Fiber Comp. - $F_c$ (ksi) =	1.552844

**Boundary Element Needed -  $f_c > 0.2 f'_c$**

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$Ac_v \text{ (in}^2\text{/ft)} = 144$

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$As_{req'd} \text{ (in}^2\text{/ft)} = 0.36$

$As_{supplied} \text{ (in}^2\text{)} = 0.62$  #5 Bars

Bar Diameter (in) = 0.625

Required Spacing -  $S_{req'd} \text{ (in)} = 20.66667$  **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied -  $S_{supplied} \text{ (in)} = 18$

**Shear Capacity Check**

$\alpha_c = h_w/l_w = 2$  **hw/lw > 2 therefore use 2**

$Ac_{v_{total}} \text{ (in}^2\text{)} = 2963.52$

Transverse -  $\rho_t = 0.00287$

Nominal Shear Capacity -  $V_n \text{ (kip)} = 885.2429$

Shear Capacity -  $\phi V_n \text{ (kip)} = 531.1458$  **OK**

**Boundary Element Capacity Check**

$A_{st} \text{ (in}^2\text{)} = 12.48$  8-#11

$\rho_{st} = 0.021667$  **OK**

$P_n \text{ (max) (kip)} = 2131.814$

Axial Load Capacity -  $\phi P_n \text{ (kip)} = 1492.27$  **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max} \text{ (in)} = 4$

Vert. Spacing Supplied -  $S_{supplied} \text{ (in)} = 4$

Short Direction (in) = 24

Long Direction (in) = 24

Bar Diameter (in) = 0.625 #5 Bar

Cover from center of Vert. Reinf. To Col. Face (in) = 3

As of one Bar (in<sup>2</sup>) = 0.31

Area Bounded by out-to-out of hoops -  $A_{ch} \text{ (in}^2\text{)} = 395.0156$

**Short Direction**

Number of Crossties In Short Direction = 3

$h_c \text{ (in)} = 19.25$

Req'd Reinf. In Short Direction -  $A_{sh} \text{ (in}^2\text{)} = 0.705582$

As provided (in<sup>2</sup>) = 0.93 **OK**

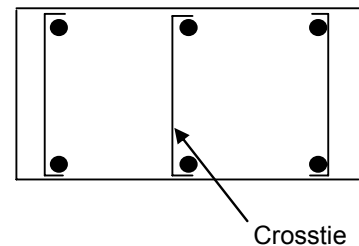
**Long Direction**

Number of Crossties In Short Direction = 3

$h_c \text{ (in)} = 19.25$

Req'd Reinf. In Short Direction -  $A_{sh} \text{ (in}^2\text{)} = 0.705582$

As provided (in<sup>2</sup>) = 0.93 **OK**

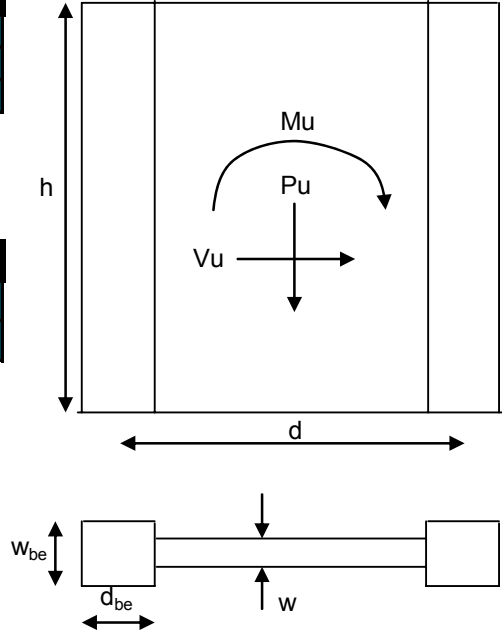


Shear Wall Design	
Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	5 - 5th through 8th

Material Properties	
Concrete Strength - $f'_c$ (psi) =	4000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	18.58
Width - $w$ (in) =	12
Height - $h$ (ft) =	77.33

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	24



Wall Loads	
$P_u$ (kip) =	1080
$M_u$ (ft-kip) =	4549
$V_u$ (kip) =	198

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	784.8332

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	20.58
$I_g$ (in <sup>4</sup> ) =	726.3649
Extreme Fiber Comp. - $F_c$ (ksi) =	0.811953

**Boundary Element Needed -  $f_c > 0.2 f'_c$**

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	18
------------------------------------------	----

**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**

$Ac_{v_{total}}$  (in<sup>2</sup>) = 2963.52

Transverse -  $\rho_t$  = 0.00287

Nominal Shear Capacity -  $V_n$  (kip) = 885.2429

Shear Capacity -  $\phi V_n$  (kip) = 531.1458 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	6.24	4-#11
-------------------------------	------	-------

$\rho_{st}$  = 0.010833 **OK**

$P_n$ (max) (kip) = 1849.267

Axial Load Capacity -  $\phi P_n$  (kip) = 1294.487 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max}$  (in) = 4

Vert. Spacing Supplied - $S_{supplied}$ (in) =	4
------------------------------------------------	---

Short Direction (in) = 24

Long Direction (in) = 24

Bar Diameter (in) =	0.625	#5 Bar
---------------------	-------	--------

Cover from center of Vert. Reinf. To Col. Face (in) =	3
-------------------------------------------------------	---

As of one Bar (in <sup>2</sup> ) =	0.31
------------------------------------	------

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 395.0156

**Short Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582

As provided (in<sup>2</sup>) = 0.93 **OK**

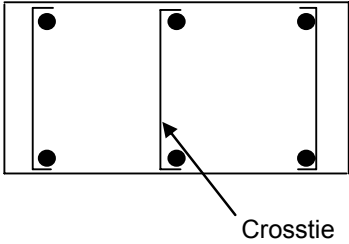
**Long Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582

As provided (in<sup>2</sup>) = 0.93 **OK**



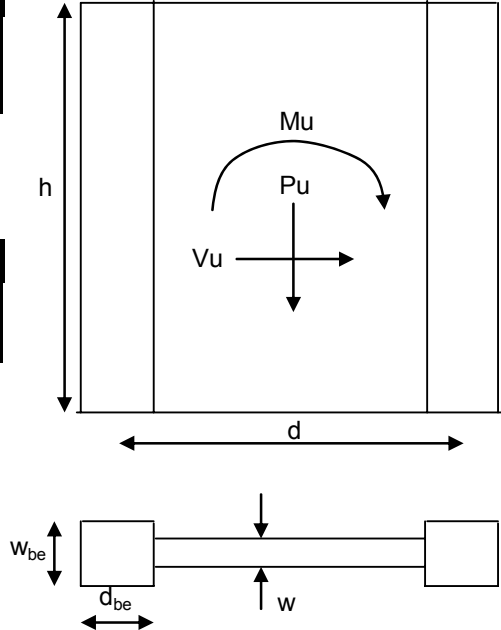
## Shear Wall Design

Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	11 - Ground Floor through 2nd

Material Properties	
Concrete Strength - $f'_c$ (psi) =	5000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	20.67
Width - $w$ (in) =	12
Height - $h$ (ft) =	118

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	24



Wall Loads	
$P_u$ (kip) =	1745
$M_u$ (ft-kip) =	20917
$V_u$ (kip) =	407

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1884.45

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	22.67
$I_g$ (in <sup>4</sup> ) =	970.8973
Extreme Fiber Comp. - $F_c$ (ksi) =	2.230382

Boundary Element Needed -  $f_c > 0.2 f'_c$



ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	16
------------------------------------------	----

**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**

$Ac_{v_{total}}$  (in<sup>2</sup>) = 3264.48

Transverse -  $\rho_t = 0.003229$

Nominal Shear Capacity -  $V_n$  (kip) = 1094.16

Shear Capacity -  $\phi V_n$  (kip) = 656.4961 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	18.72	12-#11
-------------------------------	-------	--------

$\rho_{st} = 0.0325$  **OK**

$P_n$ (max) (kip) = 2793.312

Axial Load Capacity -  $\phi P_n$  (kip) = 1955.318 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max}$  (in) = 4

Vert. Spacing Supplied - $S_{supplied}$ (in) =	4
------------------------------------------------	---

Short Direction (in) = 24

Long Direction (in) = 24

Bar Diameter (in) =	0.625	#5 Bar
---------------------	-------	--------

Cover from center of Vert. Reinf. To Col. Face (in) =	3
-------------------------------------------------------	---

As of one Bar (in <sup>2</sup> ) =	0.31
------------------------------------	------

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 395.0156

**Short Direction**

Number of Crossties In Short Direction =	4
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.881978

As provided (in<sup>2</sup>) = 1.24 **OK**

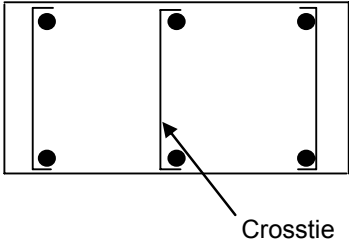
**Long Direction**

Number of Crossties In Short Direction =	4
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.881978

As provided (in<sup>2</sup>) = 1.24 **OK**

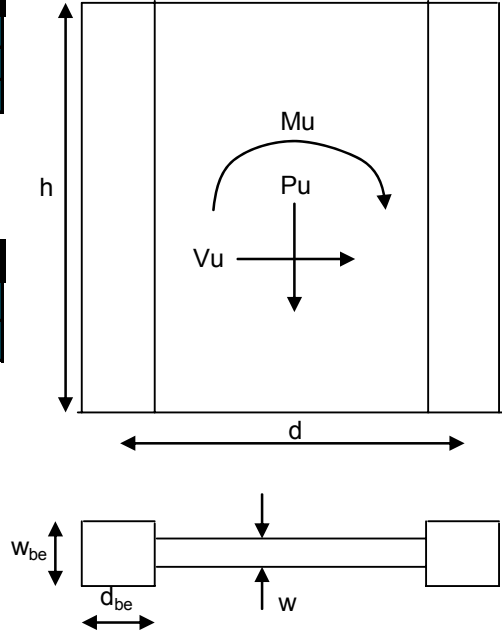


Shear Wall Design	
Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	11 - 3rd through 8th

Material Properties	
Concrete Strength - $f'_c$ (psi) =	4000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	20.67
Width - $w$ (in) =	12
Height - $h$ (ft) =	77.33

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	24



Wall Loads	
$P_u$ (kip) =	1192
$M_u$ (ft-kip) =	11670
$V_u$ (kip) =	431

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1160.586

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	22.67
$I_g$ (in <sup>4</sup> ) =	970.8973
Extreme Fiber Comp. - $F_c$ (ksi) =	1.311285

**Boundary Element Needed -  $f_c > 0.2 f'_c$**

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**Two Curtains of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	18
------------------------------------------	----

**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**

$Ac_{vtotal}$  (in<sup>2</sup>) = 3264.48

Transverse -  $\rho_t$  = 0.00287

Nominal Shear Capacity -  $V_n$  (kip) = 975.1437

Shear Capacity -  $\phi V_n$  (kip) = 585.0862 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	6.24	4-#11
-------------------------------	------	-------

$\rho_{st}$  = 0.010833 **OK**

$P_n$ (max) (kip) = 1849.267

Axial Load Capacity -  $\phi P_n$  (kip) = 1294.487 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max}$  (in) = 4

Vert. Spacing Supplied - $S_{supplied}$ (in) =	4
------------------------------------------------	---

Short Direction (in) = 24

Long Direction (in) = 24

Bar Diameter (in) =	0.625	#5 Bar
---------------------	-------	--------

Cover from center of Vert. Reinf. To Col. Face (in) =	3
-------------------------------------------------------	---

As of one Bar (in <sup>2</sup> ) =	0.31
------------------------------------	------

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 395.0156

**Short Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582

As provided (in<sup>2</sup>) = 0.93 **OK**

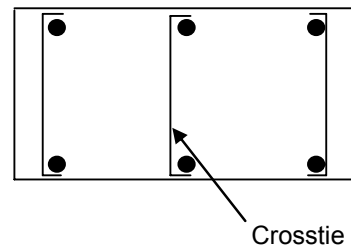
**Long Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582

As provided (in<sup>2</sup>) = 0.93 **OK**



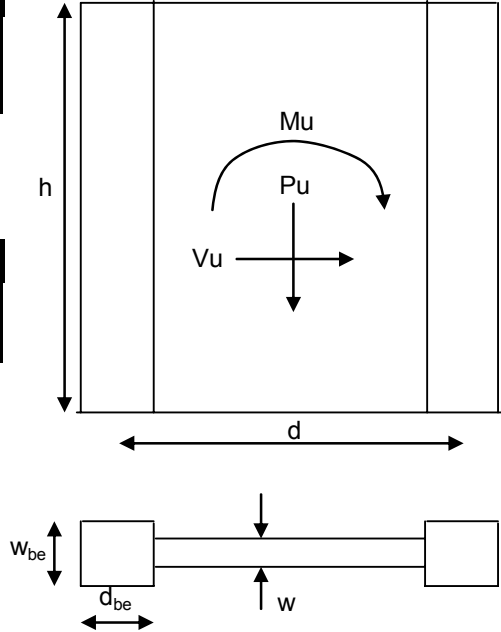
## Shear Wall Design

Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	12 - Ground Floor through 2nd

Material Properties	
Concrete Strength - $f'_c$ (psi) =	5000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	18.5
Width - $w$ (in) =	12
Height - $h$ (ft) =	118

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	26
Width - $w_{be}$ (in) =	26



Wall Loads	
$P_u$ (kip) =	2148
$M_u$ (ft-kip) =	28628
$V_u$ (kip) =	498

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	2621.459

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	20.66667
$I_g$ (in <sup>4</sup> ) =	735.5802
Extreme Fiber Comp. - $F_c$ (ksi) =	3.514568

Boundary Element Needed -  $f_c > 0.2 f'_c$

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**Two Curtains of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	18
------------------------------------------	----

**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**

$Ac_{v_{total}}$  (in<sup>2</sup>) = 2976

Transverse -  $\rho_t$  = 0.00287

Nominal Shear Capacity -  $V_n$  (kip) = 933.4033

Shear Capacity -  $\phi V_n$  (kip) = 560.042 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	37.44	24-#11
-------------------------------	-------	--------

$\rho_{st}$  = 0.055385 **OK**

$P_n$ (max) (kip) = 3968.224

Axial Load Capacity -  $\phi P_n$  (kip) = 2777.757 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing -  $S_{max}$  (in) = 4

Vert. Spacing Supplied - $S_{supplied}$ (in) =	4
------------------------------------------------	---

Short Direction (in) = 26

Long Direction (in) = 26

Bar Diameter (in) =	0.625	#5 Bar
---------------------	-------	--------

Cover from center of Vert. Reinf. To Col. Face (in) =	3
-------------------------------------------------------	---

As of one Bar (in <sup>2</sup> ) =	0.31
------------------------------------	------

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 478.5156

**Short Direction**

Number of Crossties In Short Direction =	4
------------------------------------------	---

$h_c$  (in) = 21.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.876992

As provided (in<sup>2</sup>) = 1.24 **OK**

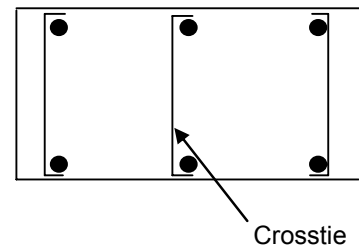
**Long Direction**

Number of Crossties In Short Direction =	4
------------------------------------------	---

$h_c$  (in) = 21.25

Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.876992

As provided (in<sup>2</sup>) = 1.24 **OK**



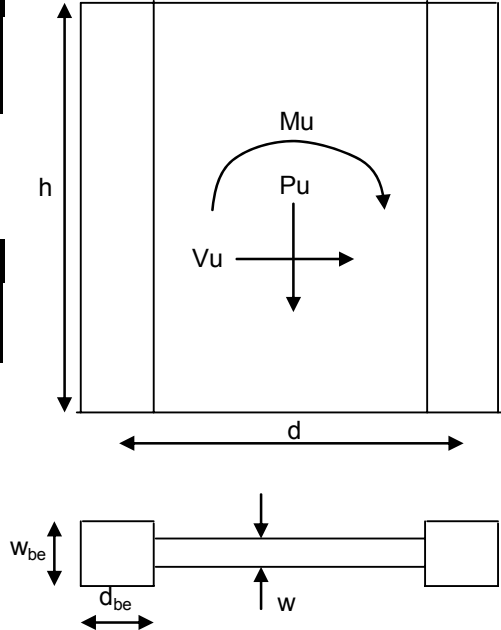
## Shear Wall Design

Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	12 - 3rd through 8th

Material Properties	
Concrete Strength - $f'_c$ (psi) =	4000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	18.5
Width - $w$ (in) =	12
Height - $h$ (ft) =	77.33

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	24



Wall Loads	
$P_u$ (kip) =	1492
$M_u$ (ft-kip) =	14122
$V_u$ (kip) =	306

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1509.351

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	20.5
$I_g$ (in <sup>4</sup> ) =	717.9271
Extreme Fiber Comp. - $F_c$ (ksi) =	1.905579

**Boundary Element Needed -  $f_c > 0.2 f'_c$**

ACI 21.7.2.2

**Longitudinal & Transverse Reinforcement**

**One Curtain of Reinf. Req.**

$Ac_v$  (in<sup>2</sup>/ft) = 144  
 Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$   
 $As_{req'd}$  (in<sup>2</sup>/ft) = 0.36

$As_{supplied}$ (in <sup>2</sup> ) =	0.62	#5 Bars
Bar Diameter (in) =	0.625	

Required Spacing -  $S_{req'd}$  (in) = 20.66667 **NOT OK Spacing Must Be Less Than 18in**

Spacing Supplied - $S_{supplied}$ (in) =	18
------------------------------------------	----

**Shear Capacity Check**

$\alpha_c = h_w/l_w$  = 2 **hw/lw > 2 therefore use 2**  
 $Ac_{vtotal}$  (in<sup>2</sup>) = 2952  
 Transverse -  $\rho_t$  = 0.00287  
 Nominal Shear Capacity -  $V_n$  (kip) = 881.8017  
 Shear Capacity -  $\phi V_n$  (kip) = 529.081 **OK**

**Boundary Element Capacity Check**

$A_{st}$ (in <sup>2</sup> ) =	18.72	12-#11
-------------------------------	-------	--------

$\rho_{st}$  = 0.0325 **OK**  
 $P_n(max)$  (kip) = 2414.362  
 Axial Load Capacity -  $\phi P_n$  (kip) = 1690.053 **OK**

**Check With Interaction Diagram**

**Determine Confinement Reinforcement for Boundary Elements**

Max. Allowable Vert. Spacing - $S_{max}$ (in) =	4	
Vert. Spacing Supplied - $S_{supplied}$ (in) =	4	
Short Direction (in) =	24	
Long Direction (in) =	24	
Bar Diameter (in) =	0.625	#5 Bar
Cover from center of Vert. Reinf. To Col. Face (in) =	3	
As of one Bar (in <sup>2</sup> ) =	0.31	

Area Bounded by out-to-out of hoops -  $A_{ch}$  (in<sup>2</sup>) = 395.0156

**Short Direction**

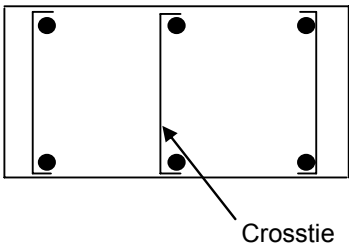
Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25  
 Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582  
 As provided (in<sup>2</sup>) = 0.93 **OK**

**Long Direction**

Number of Crossties In Short Direction =	3
------------------------------------------	---

$h_c$  (in) = 19.25  
 Req'd Reinf. In Short Direction -  $A_{sh}$  (in<sup>2</sup>) = 0.705582  
 As provided (in<sup>2</sup>) = 0.93 **OK**

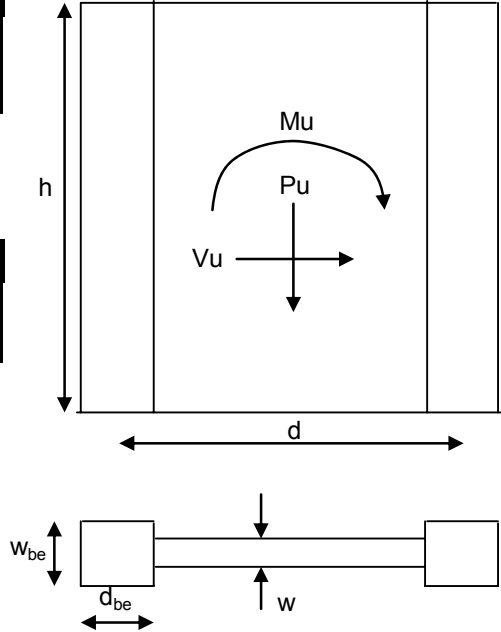


Shear Wall Design	
Engineer:	Joe Sharkey
Date:	3/19/2007
Job:	Christiana Hospital Project
Shear Wall #	25,26 - Ground through 2nd Floor

Material Properties	
Concrete Strength - $f'_c$ (psi) =	5000
Reinforcement Strength - $f_y$ (psi) =	60000

Wall Dimensions	
Length - $d$ (ft) =	28
Width - $w$ (in) =	12
Height - $h$ (ft) =	46.3

Boundary Element Dimensions	
Length - $d_{be}$ (in) =	24
Width - $w_{be}$ (in) =	12



Wall Loads	
$P_u$ (kip) =	2625
$M_u$ (ft-kip) =	8091
$V_u$ (kip) =	241

Boundary Element	
Axial Force - $P_{u_{be}}$ (kip) =	1601.464

ACI 21.7.6.3

Boundary Element Check	
$A_g$ (ft <sup>2</sup> ) =	30
$I_g$ (in <sup>4</sup> ) =	2250
Extreme Fiber Comp. - $F_c$ (ksi) =	0.982222

**OK Without Boundary Element**



ACI 21.7.2.2

### Longitudinal & Transverse Reinforcement

#### One Curtain of Reinf. Req.

$$Ac_v \text{ (in}^2\text{/ft)} = 144$$

Longitudinal -  $\rho_l$ , Transverse -  $\rho_t \geq 0.0025$

$$As_{\text{req'd}} \text{ (in}^2\text{/ft)} = 0.36$$

$$As_{\text{supplied}} \text{ (in}^2\text{)} = 0.62 \text{ \#5 Bars}$$

$$\text{Bar Diameter (in)} = 0.625$$

$$\text{Required Spacing - } S_{\text{req'd}} \text{ (in)} = 20.66667 \text{ NOT OK Spacing Must Be Less Than 18in}$$

$$\text{Spacing Supplied - } S_{\text{supplied}} \text{ (in)} = 18$$

### Shear Capacity Check

$$\alpha_c = h_w/l_w = 1.543333$$

$$Ac_{v\text{total}} \text{ (in}^2\text{)} = 4320$$

$$\text{Transverse - } \rho_t = 0.00287$$

$$\text{Nominal Shear Capacity - } V_n \text{ (kip)} = 1215.442$$

$$\text{Shear Capacity - } \phi V_n \text{ (kip)} = 729.2653 \text{ OK}$$

### Check With Interaction Diagram

