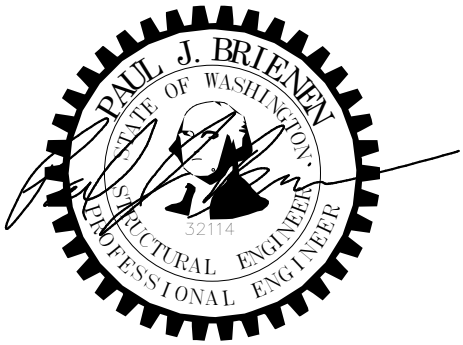
BSE

Brienen ***S***tructural ***E***ngineers, P.S.

New Level 360 - Unit 900-20

South Hill Mall
3500 South Meridian Blvd
Puyallup, WA 98373

Wall Openings in Existing Tilt-Up Concrete
Structural Calculations



Project Number 22458
12/12/2022

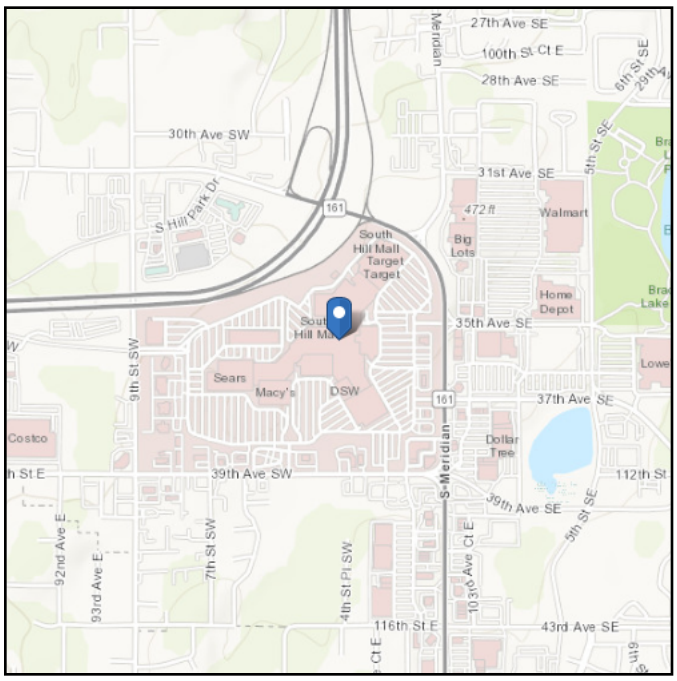
Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

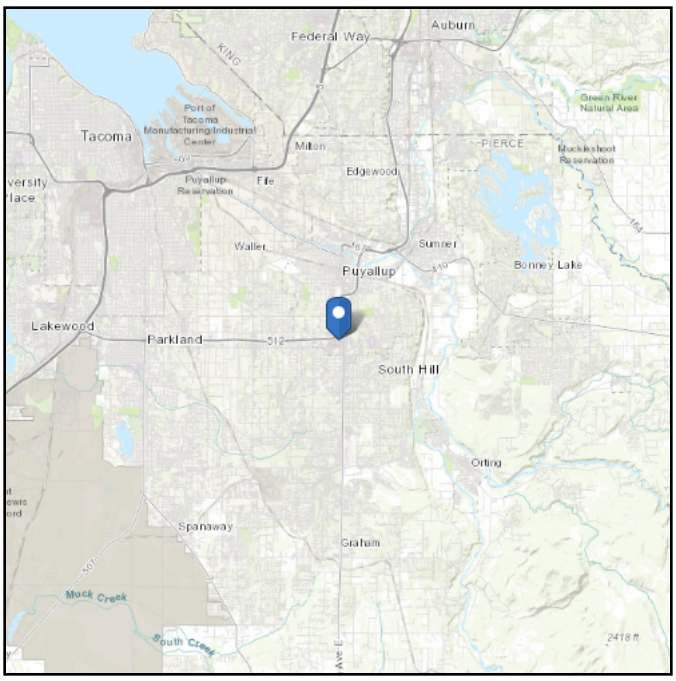
ASCE 7 Hazards Report

Address:
3500 S Meridian
Puyallup, Washington
98373

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Default (see Section 11.4.3)

Latitude: 47.158062
Longitude: -122.296741
Elevation: 438.21 ft (NAVD 88)





Wind

Results:

Wind Speed	104 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1C and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Mon Dec 12 2022

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (annual exceedance probability = 0.000588, MRI = 1,700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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MecaWind v2405

Calculations Prepared by:
Brienen Structural Engineers
1316 Central Ave S Ste 200
Kent, WA, 98032
Date: Dec 12, 2022
Designer: BJB

Calculations Prepared For:
Client: Cafaro Co
Project #: 24458
Location: Puyallup, WA
Description:
Round One

File Location : G:\2022\24458 Round One Wall Openings\Calcs\24458 Round One Wind Load.wnd

Basic Wind Parameters

Wind Load Standard	= ASCE 7-16	Exposure Category	= B
Wind Design Speed	= 104.0 mph	Risk Category	= III
Structure Type	= Building	Building Type	= Enclosed

General Wind Settings

Incl_LF	= Include ASD Load Factor of 0.6 in Pressures	= False
DynType	= Dynamic Type of Structure	= Rigid
Zg	= Altitude (Ground Elevation) above Sea Level	= 0.000 ft
Bdist	= Base Elevation of Structure	= 0.000 ft
SDB	= Simple Diaphragm Building	= True
Reacs	= Show the Base Reactions in the output	= False
MWFRSType	= MWFRS Method Selected	= Ch 27 Pt 1

Topographic Factor per Fig 26.8-1

Topo	= Topographic Feature	= None
Kzt	= Topographic Factor	= 1.000

Building Inputs

RoofType:	Building Roof Type	= Flat	RfHt :	Roof Height	= 21.000 ft
W :	Building Width	= 262.000 ft	L :	Building Length	= 314.000 ft
Par :	Is there a Parapet	= False			

Exposure Constants per Table 26.11-1:

Alpha:	Table 26.11-1 Const	= 7.000	Zg:	Table 26.11-1 Const	= 1200.000 ft
At:	Table 26.11-1 Const	= 0.143	Bt:	Table 26.11-1 Const	= 0.840
Am:	Table 26.11-1 Const	= 0.250	Bm:	Table 26.11-1 Const	= 0.450
C:	Table 26.11-1 Const	= 0.300	Eps:	Table 26.11-1 Const	= 0.333

Main Wind Force Resisting System (MWFRS) Calculations per Ch 27 Part 1:

h	= Mean Roof Height above grade	= 21.000 ft
Kh	= 15 ft [4.572 m]< Z <Zg -->(2.01*(Z/zg)^(2/Alpha) {Table 26.10-1}	= 0.633
Kzt	= Topographic Factor is 1 since no Topographic feature specified	= 1.000
Kd	= Wind Directionality Factor per Table 26.6-1	= 0.85
Zg	= Elevation above Sea Level	= 0.000 ft
Ke	= Ground Elevation Factor: Ke = e^-(0.0000362*Zg) {Table 26.9-1}	= 1.000
GCPi	= Ref Table 26.13-1 for Enclosed Building	= +/-0.18
RA	= Roof Area	= 82268.00 sq ft
LF	= Load Factor based upon STRENGTH Design	= 1.00
qh	= (0.00256 * Kh * Kzt * Kd * Ke * V^2) * LF	= 14.89 psf
qin	= For Negative Internal Pressure of Enclosed Building use qh*LF	= 14.89 psf
qip	= For Positive Internal Pressure of Enclosed Building use qh*LF	= 14.89 psf

Gust Factor Calculation:

Gust Factor Category I Rigid Structures - Simplified Method		
G1	= For Rigid Structures (Nat. Freq.>1 Hz) use 0.85	= 0.85
Gust Factor Category II Rigid Structures - Complete Analysis		
Zm	= Max(0.6 * Ht, Zmin)	= 30.000 ft
Izm	= Cc * (33 / Zm) ^ 0.167	= 0.305
Lzm	= L * (Zm / 33) ^ Eps	= 309.993
B	= Structure Width Normal to Wind	= 314.000 ft
Q	= (1 / (1 + 0.63 * ((B + Ht) / Lzm)^0.63))^0.5	= 0.776

G2 = 0.925*((1+0.7*Izm*3.4*Q)/(1+0.7*3.4*Izm)) = 0.793

Gust Factor Used in Analysis

G = Lessor Of G1 Or G2 = 0.793

MWFRS Wind Normal to Ridge (Ref Fig 27.3-1}

h	= Mean Roof Height Of Building	= 21.000 ft
RHt	= Ridge Height Of Roof	= 21.000 ft
B	= Horizontal Dimension Of Building Normal To Wind Direction	= 314.000 ft
L	= Horizontal Dimension Of building Parallel To Wind Direction	= 262.000 ft
L/B	= Ratio Of L/B used For Cp determination	= 0.834
h/L	= Ratio Of h/L used For Cp determination	= 0.080
Slope	= Slope of Roof	= 0.0 Deg
Roof	= Roof Coeff (0 to h/2) (0.000 ft to 10.500 ft)	= -0.18, -0.9
Roof	= Roof Coeff (h/2 to h) (10.500 ft to 21.000 ft)	= -0.18, -0.9
Roof	= Roof Coeff (h to 2h) (21.000 ft to 42.000 ft)	= -0.18, -0.5
Roof	= Roof Coeff (>2h) (>42.000 ft)	= -0.18, -0.3
Cp_WW	= Windward Wall Coefficient (All L/B Values)	= 0.80
Cp_LW	= Leward Wall Coefficient using L/B	= -0.50
Cp_SW	= Side Wall Coefficient (All L/B values)	= -0.70
GCpn_WW	= Parapet Combined Net Pressure Coefficient (Windward Parapet)	= 1.50
GCpn_LW	= Parapet Combined Net Pressure Coefficient (Leeward Parapet)	= -1.00

Wall Wind Pressures based On Positive Internal Pressure (+GCPi) - Normal to Ridge
All wind pressures include a load factor of 1.0

Elev ft	Kz	Kzt	qz psf	GCPi	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
21.00	0.633	1.000	14.89	0.18	6.76	-8.58	-10.94	15.35	16.00

Wall Wind Pressures based on Negative Internal Pressure (-GCPi) - Normal to Ridge
All wind pressures include a load factor of 1.0

Elev ft	Kz	Kzt	qz psf	GCPi	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
21.00	0.633	1.000	14.89	-0.18	12.12	-3.22	-5.58	15.35	16.00

Notes Wall Pressures:
Kz = Velocity Press Exp Coeff Kzt = Topographical Factor
qz = 0.00256*Kz*Kzt*Kd*V^2 GCPi = Internal Press Coefficient
Side = qh * G * Cp_SW - qip * +GCPi Windward = qz * G * Cp_WW - qip * +GCPi
Leeward = qh * G * Cp_LW - qip * +GCPi Total = Windward Press - Leeward Press
* Minimum Pressure: Para 27.1.5 no less than 16.00 psf (Incl LF) applied to Walls
+ Pressures Acting TOWARD Surface - Pressures Acting AWAY from Surface

Roof Wind Pressures for Positive & Negative Internal Pressure (+/- GCPi) - Normal to Ridge
All wind pressures include a load factor of 1.0

Roof Var	Start Dist ft	End Dist ft	Cp_min	Cp_max	GCPi	Pressure Pn_min* psf	Pressure Pp_min* psf	Pressure Pn_max psf	Pressure Pp_max psf
Roof (All)	0.000	10.500	-0.180	-0.900	0.180	0.56	-4.81	-7.94	-13.30
Roof (All)	10.500	21.000	-0.180	-0.900	0.180	0.56	-4.81	-7.94	-13.30
Roof (All)	21.000	42.000	-0.180	-0.500	0.180	0.56	-4.81	-3.22	-8.58
Roof (All)	42.000	262.000	-0.180	-0.300	0.180	0.56	-4.81	-0.86	-6.22

Notes Roof Pressures:
Start Dist = Start Dist from Windward Edge End Dist = End Dist from Windward Edge
Cp_Max = Largest Coefficient Magnitude Cp_Min = Smallest Coefficient Magnitude
Pp_max = qh*G*Cp_max - qip*(+GCPi) Pn_max = qh*G*Cp_max - qin*(-GCpi)

Pp_min* = qh*G*Cp_min - qip*(+GCPi) Pn_min* = qh*G*Cp_min - qin*(-GCPi)
OH = Overhang X = Dir along Ridge Y = Dir Perpendcular to Ridge Z = Vertical
* The smaller uplift pressures due to Cp_Min can become critical when wind is combined with roof live load or snow load; load combinations are given in ASCE 7
+ Pressures Acting TOWARD Surface - Pressures Acting AWAY from Surface

MWFRS Wind Parallel to Ridge (Ref Fig 27.3-1)

h	= Mean Roof Height Of Building	= 21.000 ft
RHt	= Ridge Height Of Roof	= 21.000 ft
B	= Horizontal Dimension Of Building Normal To Wind Direction	= 262.000 ft
L	= Horizontal Dimension Of building Parallel To Wind Direction	= 314.000 ft
L/B	= Ratio Of L/B used For Cp determination	= 1.198
h/L	= Ratio Of h/L used For Cp determination	= 0.067
Slope	= Slope of Roof	= 0.0 Deg
Roof	= Roof Coeff (0 to h/2) (0.000 ft to 10.500 ft)	= -0.18, -0.9
Roof	= Roof Coeff (h/2 to h) (10.500 ft to 21.000 ft)	= -0.18, -0.9
Roof	= Roof Coeff (h to 2h) (21.000 ft to 42.000 ft)	= -0.18, -0.5
Roof	= Roof Coeff (>2h) (>42.000 ft)	= -0.18, -0.3
Cp_WW	= Windward Wall Coefficient (All L/B Values)	= 0.80
Cp_LW	= Leward Wall Coefficient using L/B	= -0.46
Cp_SW	= Side Wall Coefficient (All L/B values)	= -0.70
GCpn_WW	= Parapet Combined Net Pressure Coefficient (Windward Parapet)	= 1.50
GCpn_LW	= Parapet Combined Net Pressure Coefficient (Leeward Parapet)	= -1.00

Wall Wind Pressures based On Positive Internal Pressure (+GCPi) - Parallel to Ridge
All wind pressures include a load factor of 1.0

Elev ft	Kz	Kzt	qz psf	GCPi	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
21.00	0.633	1.000	14.89	0.18	6.76	-8.11	-10.94	14.88	16.00

Wall Wind Pressures based on Negative Internal Pressure (-GCPi) - Parallel to Ridge
All wind pressures include a load factor of 1.0

Elev ft	Kz	Kzt	qz psf	GCPi	Windward Press psf	Leeward Press psf	Side Press psf	Total Press psf	Minimum Pressure* psf
21.00	0.633	1.000	14.89	-0.18	12.12	-2.75	-5.58	14.88	16.00

Notes Wall Pressures:
Kz = Velocity Press Exp Coeff Kzt = Topographical Factor
qz = 0.00256*Kz*Kzt*Kd*V^2 GCPi = Internal Press Coefficient
Side = qh * G * Cp_SW - qip * +GCPi Windward = qz * G * Cp_WW - qip * +GCPi
Leeward = qh * G * Cp_LW - qip * +GCPi Total = Windward Press - Leeward Press
* Minimum Pressure: Para 27.1.5 no less than 16.00 psf (Incl LF) applied to Walls
+ Pressures Acting TOWARD Surface - Pressures Acting AWAY from Surface

Roof Wind Pressures for Positive & Negative Internal Pressure (+/- GCPi) - Parallel to Ridge
All wind pressures include a load factor of 1.0

Roof	Var	Start Dist ft	End Dist ft	Cp_min	Cp_max	GCPi	Pressure Pn_min* psf	Pressure Pp_min* psf	Pressure Pn_max psf	Pressure Pp_max psf
Roof	(All)	0.000	10.500	-0.180	-0.900	0.180	0.56	-4.81	-7.94	-13.30
Roof	(All)	10.500	21.000	-0.180	-0.900	0.180	0.56	-4.81	-7.94	-13.30
Roof	(All)	21.000	42.000	-0.180	-0.500	0.180	0.56	-4.81	-3.22	-8.58
Roof	(All)	42.000	314.000	-0.180	-0.300	0.180	0.56	-4.81	-0.86	-6.22

Notes Roof Pressures:

Start Dist = Start Dist from Windward Edge End Dist = End Dist from Windward Edge
Cp_Max = Largest Coefficient Magnitude Cp_Min = Smallest Coefficient Magnitude
Pp_max = qh*G*Cp_max - qip*(+GCPi) Pn_max = qh*G*Cp_max - qin*(-GCpi)
Pp_min* = qh*G*Cp_min - qip*(+GCPi) Pn_min* = qh*G*Cp_min - qin*(-GCPi)
OH = Overhang X = Dir along Ridge Y = Dir Perpendcular to Ridge Z = Vertical
* The smaller uplift pressures due to Cp_Min can become critical when wind is combined with roof live load or snow load; load combinations are given in ASCE 7
+ Pressures Acting TOWARD Surface - Pressures Acting AWAY from Surface

Components and Cladding (C&C) Zone Summary per Ch 30 Pt 1:

h/W	= Ratio of mean roof height to building width	= 0.080
h/L	= Ratio of mean roof height to building length	= 0.067
h	= Mean Roof Height above grade	= 21.000 ft
Kh	= 15 ft [4.572 m]< Z <Zg -->(2.01*(Z/zg)^(2/Alpha) {Table 26.10-1}	= 0.633
Kzt	= Topographic Factor is 1 since no Topographic feature specified	= 1.000
Kd	= Wind Directionality Factor per Table 26.6-1	= 0.85
GCPi	= Ref Table 26.13-1 for Enclosed Building	= +/-0.18
LF	= Load Factor based upon STRENGTH Design	= 1.00
qh	= (0.00256 * Kh * Kzt * Kd * Ke * V^2) * LF	= 14.89 psf
LHD	= Least Horizontal Dimension: Min(B, L)	= 262.000 ft
a1	= Min(0.1 * LHD, 0.4 * h)	= 8.400 ft
a	= Max(a1, 0.04 * LHD, 3 ft [0.9 m])	= 10.480 ft
h/B	= Ratio of mean roof height to least hor dim: h / B	= 0.080
0.2*h	= Parameter used to define Zone 3	= 4.200 ft
0.6*h	= Parameter used to define Zones 1 and 2	= 12.600 ft

Wind Pressure Summary for C&C Zones based Upon Areas Ch 30 Pt 1 (Table 1 of 2)
All wind pressures include a load factor of 1.0

Zone	Figure	A <= 10.00 sq ft psf	A = 20.00 sq ft psf	A = 50.00 sq ft psf	A = 100.00 sq ft psf
1	30.3-2A	16.00 -28.00	16.00 -26.15	16.00 -23.71	16.00 -21.86
1'	30.3-2A	16.00 -16.08	16.00 -16.08	16.00 -16.08	16.00 -16.08
2	30.3-2A	16.00 -36.93	16.00 -34.56	16.00 -31.42	16.00 -29.04
3	30.3-2A	16.00 -50.33	16.00 -45.58	16.00 -39.31	16.00 -34.56
4	30.3-1	16.08 -17.42	16.00 -16.71	16.00 -16.00	16.00 -16.00
5	30.3-1	16.08 -21.44	16.00 -20.02	16.00 -18.14	16.00 -16.71

CONTROLLING WIND LOADS — BOTH OPENINGS ARE BEYOND "a = 10.480 ft" THEREFORE, W = -17.42 PSF CONTROLLS

BSE
Brienen Structural Engineers, P.S.

Project: ROUND ONE OPNGS Date: 12/12/2022

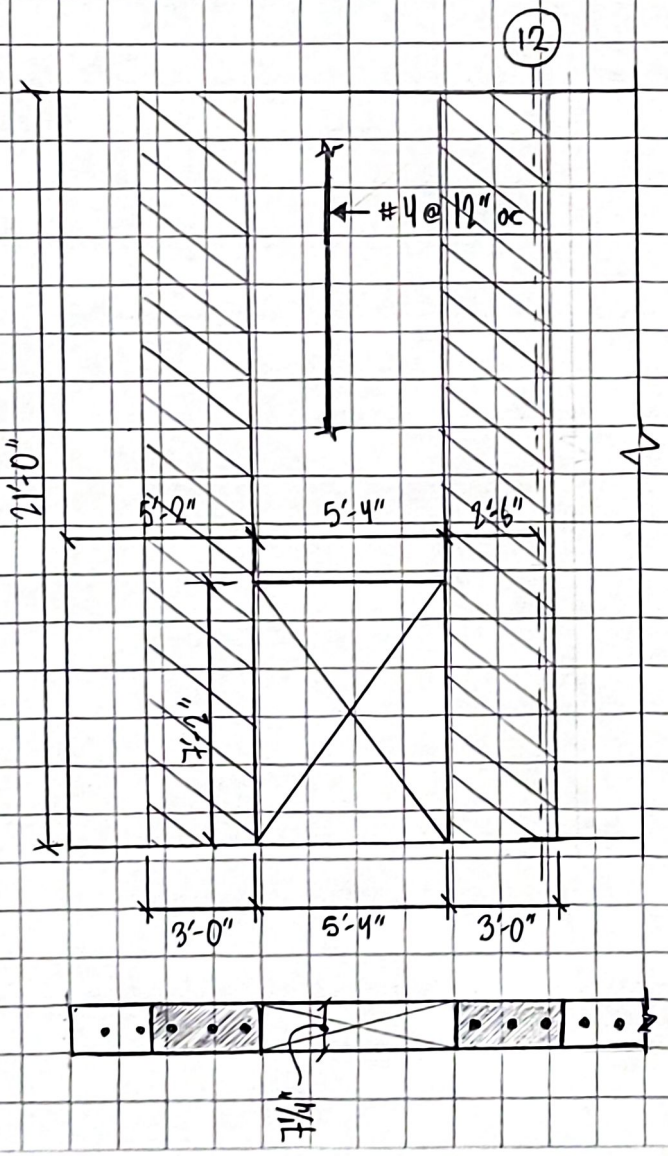
WALL OPENINGS

GRID LINE A - TOTAL EXISTING WALL = 286'-4"

NEW OPENING = 7'-2" TALL × 5'-4" WIDE.
NO EXISTING CONNECTIONS ARE INTERRUPTED.

PERCENTAGE DECREASE = $\frac{5.33\text{ ft}}{286.33\text{ ft}}$ = 1.9% << 10% ALLOWABLE PER IEBC § 503.4

CHECK OUT-OF-PLANE CAPACITY AROUND OPENINGS:



WIND LOAD = 17.42 PSF (ATTACHED)

ASSUME 3 ft OF WALL ON EA SIDE OF OPNG AS JAMB.

TRIBUTARY WIDTH = $3\text{ ft} + \frac{1}{2}(5.33\text{ ft})$
= 5.67 ft

$w = (17.42\text{ psf})(5.67\text{ ft}) = 98.8\text{ lb/ft}$

$M_u = \frac{1}{8}wL^2 = \frac{1}{8}(98.8\text{ lb/ft})(21\text{ ft})^2$
= 5446 lb-ft

$\phi M_n = 9.3\text{ k-ft} > M_u$ OK ✓ (ATTACHED)

$V_u = \frac{1}{2}wL = \frac{1}{2}(98.8\text{ lb/ft})(21\text{ ft})$
= 1037 lb

$\phi V_c = \phi 2\sqrt{f'_c}\, b_w d = 0.6(2)\sqrt{3000\text{ psi}}(36\text{in})(7.25\text{in})$
= 17154 lb >> V_u OK ✓ (ATTACHED)

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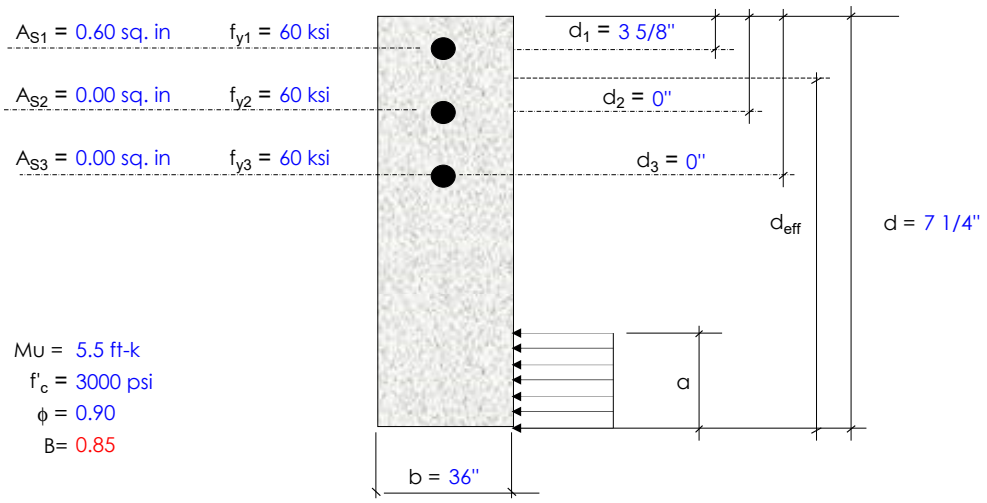
JOB TITLE: Round One Wall Openings
JOB NO: 22458
SUBJECT: Grid A Wall Opening
DESIGNER: BJB
SHEET:
DATE: 12/12/2022

Diagram/Input



Mu = 5.5 ft-k
f'c = 3000 psi
ϕ = 0.90
B= 0.85

Results

$\phi M_n = \phi T \left(d_{eff} - \frac{a}{2} \right)$ = **9.3 ft-k** **> Mu =** **5.5 ft-k** **OK**

Maximum Reinforcing Check

ρ = 0.0046 < 0.75*p bal = 0.0160
Steel Strain = 0.0206 > 0.005 ACI-19

Minimum Reinforcing Check

ρ_min > 0.0033 or 4/3*ϕ Mn > Mu

Result Summary

Strength - OK
Maximum Reinforcing Ratio - OK
Minimum Reinforcing Ratio - OK

Calculations:

$T = A_{S1} f_{y1} + A_{S2} f_{y2} + A_{S3} f_{y3}$ = 36.00 k

$d_{eff} = d - \left(\frac{A_{S1} f_{y1} d_1 + A_{S2} f_{y2} d_2 + A_{S3} f_{y3} d_3}{T} \right)$ = 7 1/4" - $\left(\frac{130.50 \text{ in-k}}{36.00 \text{ k}} \right)$ = 3.63"

$a = \frac{T}{0.85 f'_c b} = \frac{36.00 \text{ k}}{91.80 \text{ k/in}}$ = 0.39"

c= a/B1= 0.46"

Ku = Mu*12000/bd^2 = 140
Ku = ϕMn*12000/bd^2 = 235

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Beam Shear Design

MATERIAL

f'_c =	3000	psi
f_y =	60	ksi

SECTION

b_w =	36	in
d =	7.25	in

LOADS

φ =	0.6	
V_u =	1.04	kips

DESIGN

V_c = $2\sqrt{f'_c}b_w d$ = 29 kips

φV_c = 17 kips **OK!**

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Brienen **S**tructural **E**ngineers, P.S.

Project: ROUND ONE OPNGS

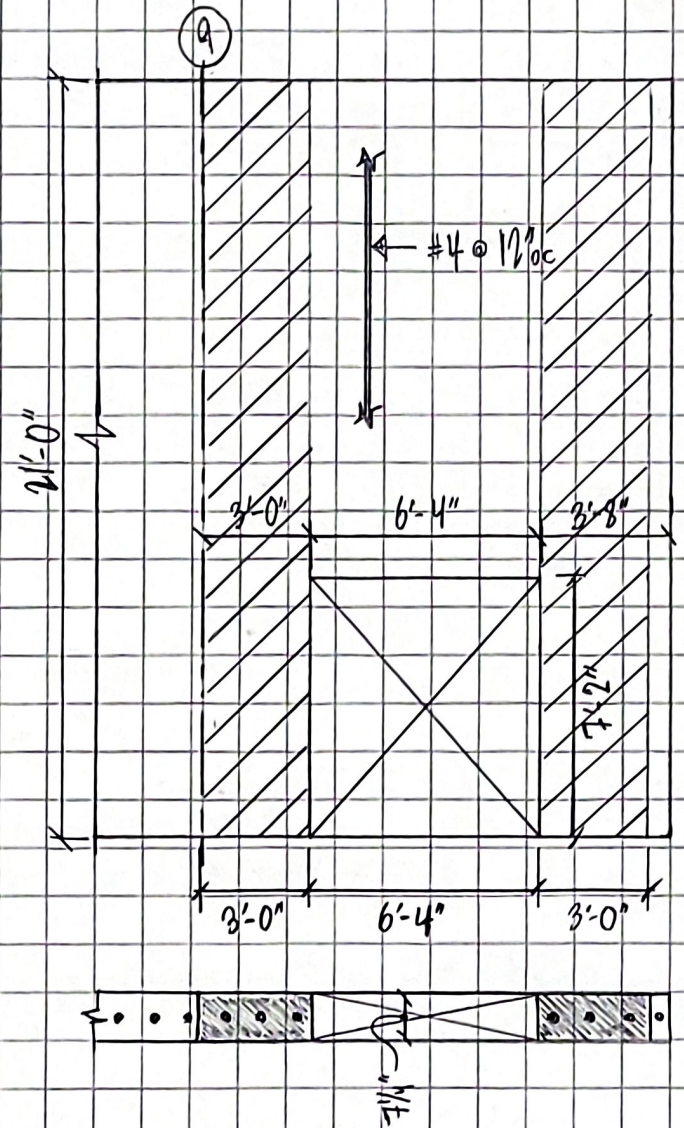
Date: 12/12/2022

GRID LINE L - TOTAL EXISTING WALL = 263'-9½"

NEW OPENING = 7'-2" TALL × 6'-4" WIDE
NO EXISTING CONNECTIONS ARE INTERRUPTED

PERCENTAGE DECREASE = $\frac{6.33\text{ ft}}{263.81\text{ ft}}$ = 2.4% << 10% ALLOWABLE PER IEBC § 503.4

CHECK OUT-OF-PLANE CAPACITY AROUND OPENINGS:



WIND LOAD = 17.42 PSF (ATTACHED)

ASSUME 3 ft OF WALL ON EA SIDE OF OPNG AS JAMB.

TRIBUTARY WIDTH = 3 ft + ½(6.33 ft)
= 6.17 ft

$w = (17.42\text{ psf})(6.17\text{ ft}) = 107.5\text{ lb/ft}$

$M_u = \frac{1}{8}wL^2 = \frac{1}{8}(107.5\text{ lb/ft})(21\text{ ft})^2$
= 5926 lb·ft

$\phi M_n = 9.3\text{ k-ft} > M_u$ OK ✓ (ATTACHED)

$V_u = \frac{1}{2}wL = \frac{1}{2}(107.5\text{ lb/ft})(21\text{ ft})$
= 1129 lb

$\phi V_c = \phi 2\sqrt{f'_c}\, b_w d = 0.6(2)\sqrt{3000_{psi}}(36_{in})(7.25_{in})$
= 17154 lb >> V_u OK ✓ (ATTACHED)

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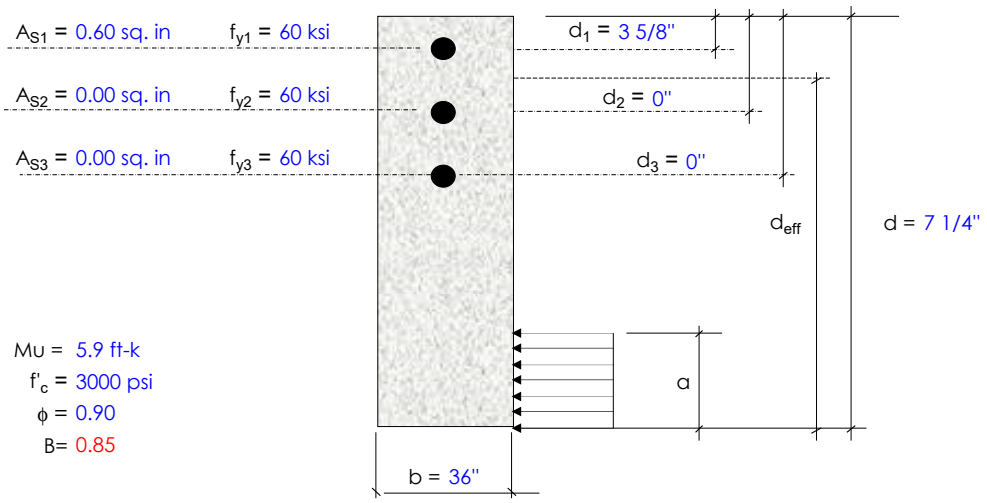
JOB TITLE: Round One Wall Openings
JOB NO: 22458
SUBJECT: Grid L Wall Opening
DESIGNER: BJB
SHEET:
DATE: 12/12/2022

Diagram/Input



Mu = 5.9 ft-k
f'c = 3000 psi
ϕ = 0.90
B= 0.85

Results

$\phi M_n = \phi T \left(d_{eff} - \frac{a}{2} \right)$ = **9.3 ft-k** **> Mu =** **5.9 ft-k** **OK**

Maximum Reinforcing Check

ρ = 0.0046 < 0.75*p bal = 0.0160
Steel Strain = 0.0206 > 0.005 ACI-19

Minimum Reinforcing Check

ρ_min > 0.0033 or 4/3*ϕ Mn > Mu

Result Summary

Strength - OK
Maximum Reinforcing Ratio - OK
Minimum Reinforcing Ratio - OK

Calculations:

$T = A_{S1} f_{y1} + A_{S2} f_{y2} + A_{S3} f_{y3}$ = 36.00 k

$d_{eff} = d - \left(\frac{A_{S1} f_{y1} d_1 + A_{S2} f_{y2} d_2 + A_{S3} f_{y3} d_3}{T} \right)$ = 7 1/4" - (130.50 in-k / 36.00 k) = 3.63"

$a = \frac{T}{0.85 f'_c b} = \frac{36.00 \text{ k}}{91.80 \text{ k/in}}$ = 0.39"

c= a/B1= 0.46"

Ku = Mu*12000/bd^2 = 150
Ku = ϕMn*12000/bd^2 = 235

BSE

***B*rienen *S*tructural *E*ngineers, P.S.**

Beam Shear Design

MATERIAL

f'_c =	3000	psi
f_y =	60	ksi

SECTION

b_w =	36	in
d =	7.25	in

LOADS

φ =	0.6	
V_u =	1.13	kips

DESIGN

V_c = $2\sqrt{f'_c}b_w d$ = 29 kips

φV_c = 17 kips OK!

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