Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

wall W1, Floor 1

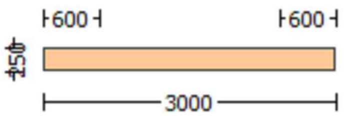
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

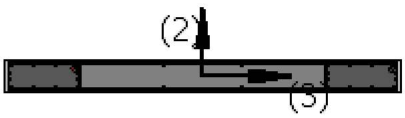
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.3025053E-010
Shear Force, Va = -6.3979846E-014
EDGE -B-
Bending Moment, Mb = -6.2019971E-011
Shear Force, Vb = 6.3979846E-014
BOTH EDGES
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL,ten = 17.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 403305.524
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 403305.524

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 151978.111
Mu/Vu-lw/2 = 1910.806 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 1.3025053E-010
Vu = 6.3979846E-014
Nu = 27598.912
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s < d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s < d/2, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 2

wall W1, Floor 1

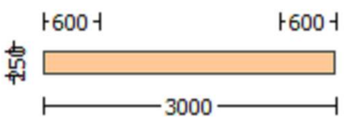
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

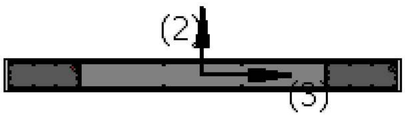
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----

with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002

λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00

As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667

From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00

lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction

which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00

ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00

d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00

ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00

ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667

From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered

characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00

Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 3
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL = 17.33333

Considering wall controlled by Shear (shear control ratio > 1),
interstorey drift provided values are calculated
Existing component: From table 7-7, ASCE 41_17: Final interstorey drift Capacity δu,R = κ*δu = 0.004
from table 10-20: δu = 0.004
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.209234
As = 0.00
As' = 6346.017
fy = 400.00
P = 27598.912
tw = 250.00
lw = 3000.00
fc = 16.00

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 3

wall W1, Floor 1

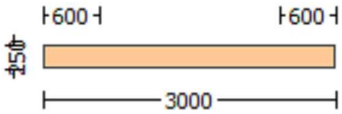
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

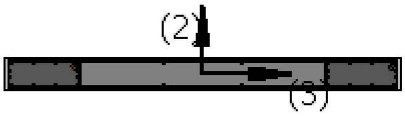
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 7.6264E+007
Shear Force, Va = -25423.336
EDGE -B-
Bending Moment, Mb = 14301.377
Shear Force, Vb = 25423.336
BOTH EDGES
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL,ten = 17.33333

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 1.6645E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.6645E+006

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 608913.747
Mu/Vu-lw/2 = 1499.748 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 7.6264E+007
Vu = 25423.336
Nu = 27598.912
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 4

wall W1, Floor 1

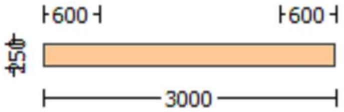
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

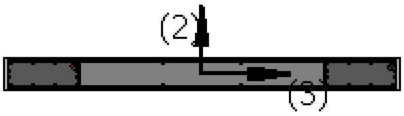
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY

For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.

with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009

----

with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.

with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00

εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->

v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00

lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00

ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667

From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered

characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00

From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->

v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236

h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d

---

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----

with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 2
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796

(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.3025053E-010
Shear Force, V2 = -6.3979846E-014
Shear Force, V3 = -25423.336
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL = 17.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00385818
θu = θy + θp = 0.00385818

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00185818 ((10-5), ASCE 41-17))
My = 2.2249E+008
(EI)Eff = 0.35*Ec*I (table 10-5)
Ec*I = 8.2106E+013
lp = 0.5*d = 0.5*(0.8*h) = 240.00

Calculation of Yielding Moment My

Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ

Φy = Min(Φy_ten,Φy_com)

Φy_ten = 1.2992433E-005
with fy = 400.00
d = 208.00
ξy = 0.25992422
A = 0.01028047
B = 0.00622229
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 27598.912
b = 3000.00
δ'' = 0.20192308
Φy_comp = 2.5448441E-005
with fc = 16.00
Ec = 21019.039
ξy = 0.25885414
A = 0.0100085
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

- Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.002
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.209234
As = 0.00
As' = 6346.017
fy = 400.00
P = 27598.912
tw = 3000.00
lw = 250.00
fc = 16.00
- V/(tw*lw*fc^0.5) = 2.5682965E-019, NOTE: units in lb & in
- Confined Boundary: No
Boundary hoops spacing does not exceed 8db (s1 < 8*db and s2 < 8*db)
Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision (Vw1 + Vw2 > 0.50*(V-Vc-Vw3)
With
Boundary Element 1:
Vw1 = 125663.706
s1 = 100.00
Boundary Element 2:
Vw2 = 125663.706
s2 = 100.00
Grid Shear Force, Vw3 = 0.00
Concrete Shear Force, Vc = 151978.111
(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, db = 17.33333
Design Shear Force, V = 6.3979846E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 5

wall W1, Floor 1

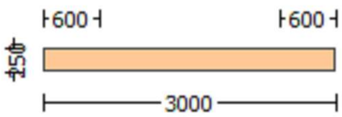
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

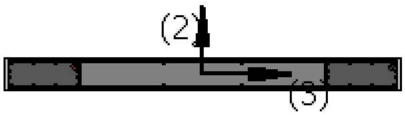
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.3025053E-010
Shear Force, Va = -6.3979846E-014
EDGE -B-
Bending Moment, Mb = -6.2019971E-011
Shear Force, Vb = 6.3979846E-014
BOTH EDGES
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL,ten = 17.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 443693.972
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 443693.972

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 192366.559
Mu/Vu-lw/2 = 844.3673 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 6.2019971E-011
Vu = 6.3979846E-014
Nu = 27598.912
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 6

wall W1, Floor 1

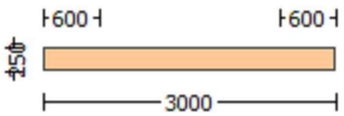
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

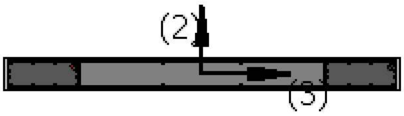
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections

Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00

ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00

v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00

εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472

ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:

d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----

with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002

λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY

For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.

with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 3
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL = 17.33333

Considering wall controlled by Shear (shear control ratio > 1),

interstorey drift provided values are calculated
Existing component: From table 7-7, ASCE 41_17: Final interstorey drift Capacity δu,R = κ*δu = 0.004
from table 10-20: δu = 0.004
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.209234
  As = 0.00
  As' = 6346.017
  fy = 400.00
  P = 27598.912
  tw = 250.00
  lw = 3000.00
  fc = 16.00

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 7

wall W1, Floor 1

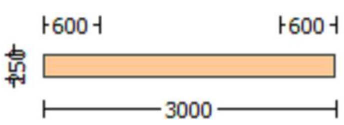
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

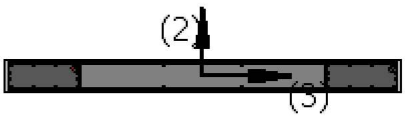
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 7.6264E+007
Shear Force, Va = -25423.336
EDGE -B-
Bending Moment, Mb = 14301.377
Shear Force, Vb = 25423.336
BOTH EDGES
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL,ten = 17.33333

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.7091E+006

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653519.782
Mu/Vu-lw/2 = -1499.437 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 14301.377
Vu = 25423.336
Nu = 27598.912
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 8

wall W1, Floor 1

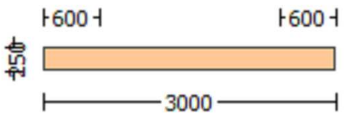
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

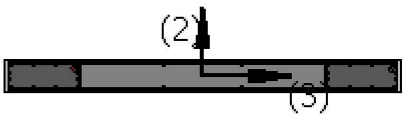
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00

As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943

and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00

ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00

εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00

Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00

Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00

As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00

with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00

As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805

ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00

bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00

εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:

b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00

Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 2
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member

Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -6.2019971E-011
Shear Force, V2 = 6.3979846E-014
Shear Force, V3 = 25423.336
Axial Force, F = -27598.912
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL = 17.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00385818
θu = θy + θp = 0.00385818

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00185818 ((10-5), ASCE 41-17))
My = 2.2249E+008
(EI)Eff = 0.35*Ec*I (table 10-5)
Ec*I = 8.2106E+013
lp = 0.5*d = 0.5*(0.8*h) = 240.00

Calculation of Yielding Moment My

Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.2992433E-005
with fy = 400.00
d = 208.00
ξy = 0.25992422
A = 0.01028047
B = 0.00622229
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 27598.912
b = 3000.00
δ" = 0.20192308
Φy_comp = 2.5448441E-005
with fc = 16.00
Ec = 21019.039
ξy = 0.25885414
A = 0.0100085
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.002
with:
 - Condition i (shear wall and wall segments)
 - (As-As')*fy+P)/(tw*lw*fc') = -0.209234
   As = 0.00
   As' = 6346.017
   fy = 400.00
   P = 27598.912
   tw = 3000.00
   lw = 250.00
   fc = 16.00
 - V/(tw*lw*fc^0.5) = 2.5682965E-019, NOTE: units in lb & in
 - Confined Boundary: No
  Boundary hoops spacing does not exceed 8db (s1 < 8*db and s2 < 8*db)
  Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision (Vw1 + Vw2 > 0.50*(V-Vc-Vw3)
  With
  Boundary Element 1:
   Vw1 = 125663.706
   s1 = 100.00
  Boundary Element 2:
   Vw2 = 125663.706
   s2 = 100.00
  Grid Shear Force, Vw3 = 0.00
  Concrete Shear Force, Vc = 192366.559
(The variables above have already been given in Shear control ratio calculation)
  Mean diameter of all bars, db = 17.33333
  Design Shear Force, V = 6.3979846E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

wall W1, Floor 1

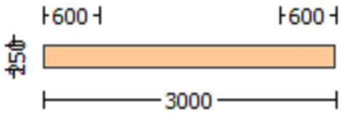
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

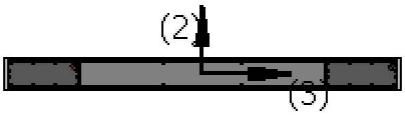
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.6181356E-010
Shear Force, Va = -7.9731059E-014
EDGE -B-
Bending Moment, Mb = -7.7792062E-011
Shear Force, Vb = 7.9731059E-014
BOTH EDGES
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL,ten = 17.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 403411.971
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 403411.971

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 152084.559
Mu/Vu-lw/2 = 1904.492 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 1.6181356E-010
Vu = 7.9731059E-014
Nu = 27619.81
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 10

wall W1, Floor 1

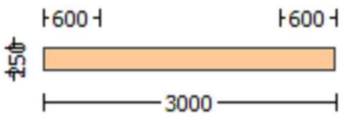
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

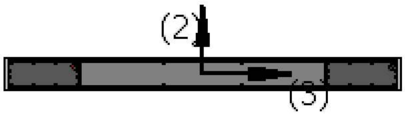
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-

Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00

with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00

ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333

εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333

εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978

Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00

ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00

d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00

Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00

As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00

and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00

As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:

d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d

----

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 3
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL = 17.33333

Considering wall controlled by Shear (shear control ratio > 1),
interstorey drift provided values are calculated
Existing component: From table 7-7, ASCE 41_17: Final interstorey drift Capacity δu,R = κ*δu = 0.015
from table 10-20: δu = 0.015
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20923225
As = 0.00
As' = 6346.017

fy = 400.00
P = 27619.81
tw = 250.00
lw = 3000.00
fc = 16.00

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 11

wall W1, Floor 1

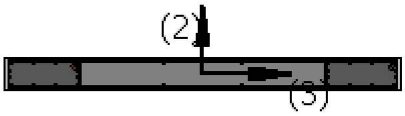
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00

Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 9.5039E+007
Shear Force, Va = -31682.313
EDGE -B-
Bending Moment, Mb = 17822.236
Shear Force, Vb = 31682.313
BOTH EDGES
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL,ten = 17.33333

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 1.6645E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.6645E+006

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 608920.436
Mu/Vu-lw/2 = 1499.748 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 9.5039E+007
Vu = 31682.313
Nu = 27619.81
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:

d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 12

wall W1, Floor 1

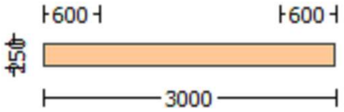
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

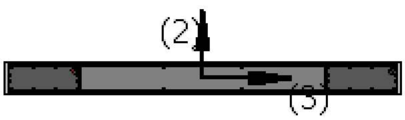
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,

the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00

d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00

s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered

characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00

with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030

Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d

---

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination

Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796

No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00

No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,

considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)

psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00

with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218

From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00

Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 2
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.6181356E-010
Shear Force, V2 = -7.9731059E-014
Shear Force, V3 = -31682.313
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL = 17.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00985819
θu = θy + θp = 0.00985819

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00185819 ((10-5), ASCE 41-17))
My = 2.2250E+008
(EI)Eff = 0.35*Ec*I (table 10-5)
Ec*I = 8.2106E+013
lp = 0.5*d = 0.5*(0.8*h) = 240.00

Calculation of Yielding Moment My

Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.2992461E-005
with fy = 400.00
d = 208.00
ξy = 0.25992587
A = 0.01028056
B = 0.00622237
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 27619.81
b = 3000.00
δ'' = 0.20192308
Φy_comp = 2.5448357E-005
with fc = 16.00
Ec = 21019.039
ξy = 0.25885499
A = 0.01000838
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

- Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.008
with:

- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20923225
  As = 0.00
  As' = 6346.017
  fy = 400.00
  P = 27619.81
  tw = 3000.00
  lw = 250.00
  fc = 16.00
- V/(tw*lw*fc^0.5) = 3.2005861E-019, NOTE: units in lb & in
- Confined Boundary: No
  Boundary hoops spacing does not exceed 8db (s1 < 8*db and s2 < 8*db)
  Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision (Vw1 + Vw2 > 0.50*(V-Vc-Vw3)
  With
  Boundary Element 1:
  Vw1 = 125663.706
  s1 = 100.00
  Boundary Element 2:
  Vw2 = 125663.706
  s2 = 100.00
  Grid Shear Force, Vw3 = 0.00
  Concrete Shear Force, Vc = 152084.559

(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, db = 17.33333
Design Shear Force, V = 7.9731059E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 13

wall W1, Floor 1

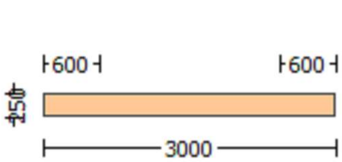
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

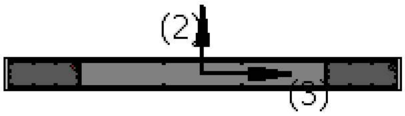
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.6181356E-010
Shear Force, Va = -7.9731059E-014
EDGE -B-
Bending Moment, Mb = -7.7792062E-011
Shear Force, Vb = 7.9731059E-014
BOTH EDGES
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL,ten = 17.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 443157.873
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 443157.873

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 191830.46
Mu/Vu-lw/2 = 850.6808 > 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 7.7792062E-011
Vu = 7.9731059E-014
Nu = 27619.81
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 14

wall W1, Floor 1

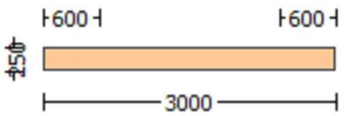
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

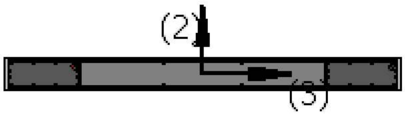
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-

Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00

with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00

ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

----

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333

εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333

εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978

Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00

ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00

d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00

Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00

As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00

and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00

As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d

----

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:

d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472
----
with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 3
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL = 17.33333

Considering wall controlled by Shear (shear control ratio > 1),
interstorey drift provided values are calculated
Existing component: From table 7-7, ASCE 41_17: Final interstorey drift Capacity δu,R = κ*δu = 0.015
from table 10-20: δu = 0.015
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20923225
As = 0.00
As' = 6346.017

fy = 400.00
P = 27619.81
tw = 250.00
lw = 3000.00
fc = 16.00

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 15

wall W1, Floor 1

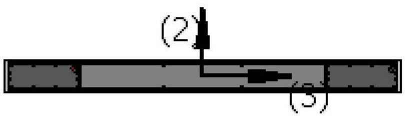
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00

Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 9.5039E+007
Shear Force, Va = -31682.313
EDGE -B-
Bending Moment, Mb = 17822.236
Shear Force, Vb = 31682.313
BOTH EDGES
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 615.7522
Mean Diameter of Tension Reinforcement, DbL,ten = 17.33333

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.7091E+006

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653523.962
Mu/Vu-lw/2 = -1499.437 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 17822.236
Vu = 31682.313
Nu = 27619.81
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:

d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 16

wall W1, Floor 1

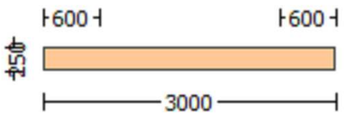
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

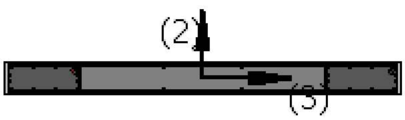
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,

the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
##
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -3.6423187E-030
EDGE -B-
Shear Force, Vb = 3.6423187E-030
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2865.133
-Compression: Asl,com = 2865.133
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 2.25608
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 3.8558E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7837E+009
Mu1+ = 5.0210E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 5.7837E+009, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 5.7837E+009
Mu2+ = 5.0210E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 5.7837E+009, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00

d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00

s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1673539E-005
Mu = 5.0210E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered

characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.06523978
Mu = MRc (4.14) = 5.0210E+009
φu = φsu (4.1) = 1.1673539E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.1958028E-005
Mu = 5.7837E+009
----
with full section properties:
b = 250.00
d = 2957.00
d' = 43.00
v = 0.00232618
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00

with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.12111652
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.12111652
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02602943
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.16099723
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.16099723
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03460028
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.08747825
Mu = MRc (4.15) = 5.7837E+009
φu = φsu (4.1) = 1.1958028E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.7091E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030

Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.7091E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d

----

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 2.8146476E-010
Vu = 3.6423187E-030
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.0556E+006
Vs1 = 301592.895 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 301592.895 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 452389.342 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 400.00
Vs3 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 16.00
Existing material of Primary Member: Steel Strength, fs = fsm = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 500.00
###
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.0366709E-032
EDGE -B-
Shear Force, Vb = 2.0366709E-032
BOTH EDGES
Axial Force, F = -27514.027
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 0.00
(According to 10.7.2.3 Asl,mid is setted equal to zero)

Calculation of Shear Capacity ratio , Ve/Vr = 0.23426757
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 211972.373
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.1796E+008
Mu1+ = 2.4327E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.1796E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination

Mpr2 = Max(Mu2+ , Mu2-) = 3.1796E+008
Mu2+ = 2.4327E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.1796E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796

No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00

No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,

considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019144
Mu = 2.4327E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)

psh,min = Min(psh,x , psh,y) = 0.0010472

----

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

----

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00
with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18965884
Mu = MRc (4.14) = 2.4327E+008
φu = φsu (4.1) = 0.00019144

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00019712
Mu = 3.1796E+008
----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00
v = 0.00275581
N = 27514.027
fc = 16.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: εcu = 0.0035
ωwe (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
Σbi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00
----
psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00208333
εsh1 = 0.00805
ft1 = 600.00
fy1 = 500.00
εsu1 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu1_nominal = 0.08066667,
For calculation of esu1_nominal and εy1,εsh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 500.00

with Es1 = Es = 200000.00
εy2 = 0.00208333
εsh2 = 0.00805
ft2 = 600.00
fy2 = 500.00
εsu2 = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esu2_nominal = 0.08066667,
For calculation of esu2_nominal and εy2,εsh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 500.00
with Es2 = Es = 200000.00
εyv = 0.00208333
εshv = 0.00805
ftv = 600.00
fyv = 500.00
εsuv = 0.03226667
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.03226667
From table 5A.1, TBDY: esuv_nominal = 0.08066667,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv,εshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1,εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 500.00
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11862785
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11862785
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08055366
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14145031
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14145031
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09605114
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2130262
Mu = MRc (4.14) = 3.1796E+008
φu = φsu (4.1) = 0.00019712

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 904830.218

Calculation of Shear Strength at edge 1, Vr1 = 904830.218

From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr1 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 904830.218
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d
----
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: Vc = 653502.805
Mu/Vu-lw/2 = 0.00 <= 0
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 3000.00
d = 200.00
lw = 250.00
Mu = 2.0446822E-012
Vu = 2.0366709E-032
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 251327.412
Vs1 = 125663.706 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 125663.706 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 100.00
fy = 400.00

Vs2 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
d = 200.00
Av = 0.00
s = 200.00
fy = 400.00
Vs3 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.00
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, κ = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, ρn < 0.0015
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
ρn = 0.0010472

---

with ρn = ps1 + ps2 + ps3, being the shear reinf. ratio in a plane perpedicular to the shear axis 2
(pseudo-col.1 ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236
h1 = 250.00
s1 = 100.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236
h2 = 250.00
s2 = 100.00
total area of hoops perpedicular to shear axis, As2 = 157.0796
(grid ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00
h3 = 250.00
s3 = 200.00
total area of hoops perpedicular to shear axis, As3 = 0.00
total section area, Ac = 750000.00

Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -7.7792062E-011
Shear Force, V2 = 7.9731059E-014
Shear Force, V3 = 31682.313
Axial Force, F = -27619.81
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 0.00
-Compression: Aslc = 6346.017
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 2368.761
-Compression: Asl,com = 2368.761
-Middle: Asl,mid = 1608.495
Mean Diameter of Tension Reinforcement, DbL = 17.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00985819
θu = θy + θp = 0.00985819

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00185819 ((10-5), ASCE 41-17))
My = 2.2250E+008
(EI)Eff = 0.35*Ec*I (table 10-5)
Ec*I = 8.2106E+013
lp = 0.5*d = 0.5*(0.8*h) = 240.00

Calculation of Yielding Moment My

Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.2992461E-005
with fy = 400.00
d = 208.00
ξy = 0.25992587
A = 0.01028056
B = 0.00622237
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 27619.81
b = 3000.00
δ'' = 0.20192308
Φy_comp = 2.5448357E-005
with fc = 16.00
Ec = 21019.039
ξy = 0.25885499
A = 0.01000838
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

- Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.008
with:

- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20923225
  As = 0.00
  As' = 6346.017
  fy = 400.00
  P = 27619.81
  tw = 3000.00
  lw = 250.00
  fc = 16.00
- V/(tw*lw*fc^0.5) = 3.2005861E-019, NOTE: units in lb & in
- Confined Boundary: No
  Boundary hoops spacing does not exceed 8db (s1 < 8*db and s2 < 8*db)
  Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision (Vw1 + Vw2 > 0.50*(V-Vc-Vw3)
  With
  Boundary Element 1:
  Vw1 = 125663.706
  s1 = 100.00
  Boundary Element 2:
  Vw2 = 125663.706
  s2 = 100.00
  Grid Shear Force, Vw3 = 0.00
  Concrete Shear Force, Vc = 191830.46
(The variables above have already been given in Shear control ratio calculation)
  Mean diameter of all bars, db = 17.33333
  Design Shear Force, V = 7.9731059E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
