Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

wall W1, Floor 1

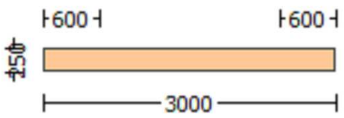
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

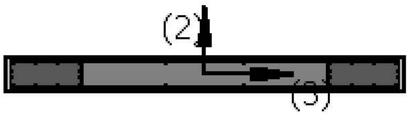
Analysis: Uniform +X

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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -7.0116784E-011
Shear Force, Va = -5.0618734E-015
EDGE -B-
Bending Moment, Mb = 5.3046422E-011
Shear Force, Vb = 5.0618734E-015
BOTH EDGES
Axial Force, F = -28999.911
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 = 312351.059
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 312351.059

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 = 124455.471
Mu/Vu-lw/2 = 13726.943 > 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 = 7.0116784E-011
Vu = 5.0618734E-015
Nu = 28999.911
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00

Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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

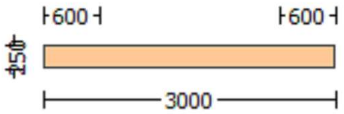
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

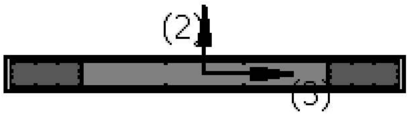
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029

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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00

ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062

λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).

This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813
----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)

Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Axial Force, F = -28999.911
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') = -0.20911725
As = 0.00
As' = 6346.017
fy = 400.00
P = 28999.911
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

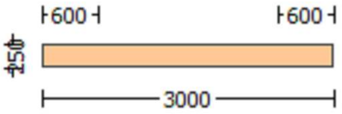
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

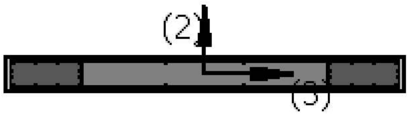
Analysis: Uniform +X

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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.7629E+007
Shear Force, Va = -22631.087
EDGE -B-
Bending Moment, Mb = 276268.656
Shear Force, Vb = 22631.087
BOTH EDGES
Axial Force, F = -28999.911
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 = 1.9920E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.9920E+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 = 613119.637
Mu/Vu-lw/2 = 1488.32 > 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 = 6.7629E+007
Vu = 22631.087
Nu = 28999.911
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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

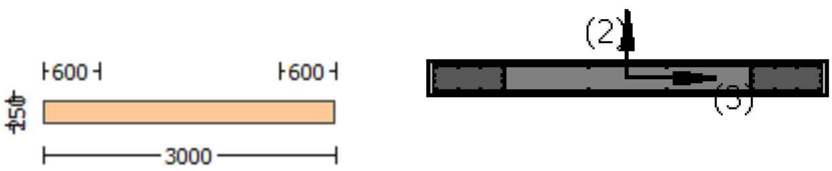
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029
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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00

fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00

h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712

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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00

ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712

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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00

From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00

sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813

----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = -7.0116784E-011
Shear Force, V2 = -5.0618734E-015
Shear Force, V3 = -22631.087
Axial Force, F = -28999.911
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 = 0.0032597
θu = θy + θp = 0.0032597

 - Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.0012597 ((10-5), ASCE 41-17))
My = 1.5083E+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 = 8.7645990E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 269.394
d = 208.00
ξy = 0.26113943
A = 0.01034241
B = 0.00628423
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 28999.911
b = 3000.00
δ'' = 0.20192308
Φy_comp = 2.5446036E-005
with fc* (12.3, (ACI 440)) = 16.002
fc = 16.00
fl = 0.17503396
b = 3000.00
h = 250.00
Ag = 750000.00
From (12.9), ACI 440: ka = 0.00364754
ρg = pt + pc + pv = 0.0101699
rc = 40.00
Ae/Ac = 0.52524587
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
effective strain from (12.5) and (12.12), efe = 0.004
εfu = 0.01
Ef = 64828.00
Ec = 21019.039
ξy = 0.25891099
A = 0.01000033
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.39548208
lb = 300.00
ld = 758.5679
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 400.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

 - 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') = -0.20911725
    As = 0.00
    As' = 6346.017
    fy = 400.00
    P = 28999.911
    tw = 3000.00
    lw = 250.00
    fc = 16.00
 - V/(tw*lw*fc^0.5) = 2.0319511E-020, NOTE: units in lb & in
 - Confined Boundary: No
   Boundary hoops spacing exceed 8db (s1 > 8*db or 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 = 83775.804
    s1 = 150.00
   Boundary Element 2:
    Vw2 = 83775.804
    s2 = 150.00
   Grid Shear Force, Vw3 = 0.00
   Concrete Shear Force, Vc = 124455.471
(The variables above have already been given in Shear control ratio calculation)
   Mean diameter of all bars, db = 17.33333
   Design Shear Force, V = 5.0618734E-015

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

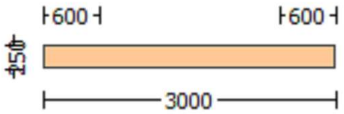
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

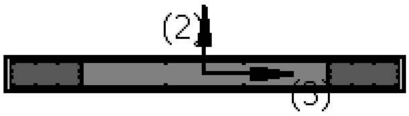
Analysis: Uniform +X

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: (d)
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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -7.0116784E-011
Shear Force, Va = -5.0618734E-015
EDGE -B-
Bending Moment, Mb = 5.3046422E-011
Shear Force, Vb = 5.0618734E-015
BOTH EDGES
Axial Force, F = -28999.911
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 = 313802.14
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 313802.14

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 = 125906.552
Mu/Vu-lw/2 = 10354.603 > 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 = 5.3046422E-011
Vu = 5.0618734E-015
Nu = 28999.911
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)

Calculation No. 6

wall W1, Floor 1

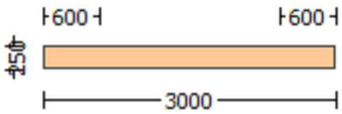
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

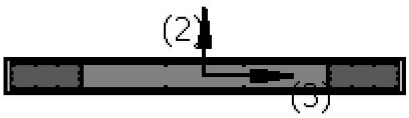
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00

Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029
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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00

ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128

bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062

λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015

ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959

with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00

ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959

with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00

Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member

Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907

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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062

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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00

effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406

εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00

ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00

$\varepsilon y2 = 0.00120915$
$\varepsilon sh2 = 0.00467215$
ft2 = 348.235
fy2 = 290.1959
$\varepsilon su2 = 0.00579712$
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 = 0.31638566
$\varepsilon su2$ = 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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
$\varepsilon yv = 0.00120915$
$\varepsilon shv = 0.00467215$
ftv = 348.235
fyv = 290.1959
$\varepsilon suv = 0.00579712$
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80

ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047

ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00

εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804

Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813

---

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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Axial Force, F = -28999.911
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') = -0.20911725
As = 0.00
As' = 6346.017
fy = 400.00
P = 28999.911
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

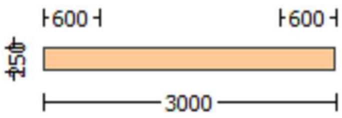
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

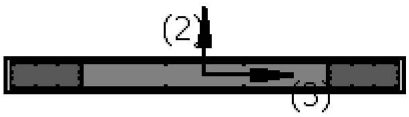
Analysis: Uniform +X

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: (d)
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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.7629E+007
Shear Force, Va = -22631.087
EDGE -B-
Bending Moment, Mb = 276268.656
Shear Force, Vb = 22631.087
BOTH EDGES
Axial Force, F = -28999.911
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 = 1.9920E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.9920E+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 = 653799.982
Mu/Vu-lw/2 = -1487.793 <= 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 = 276268.656
Vu = 22631.087
Nu = 28999.911
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633

s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)

Calculation No. 8

wall W1, Floor 1

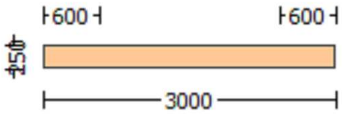
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

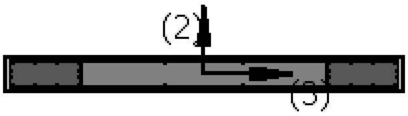
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029

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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00

ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062

λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).

This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai, as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)
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 = 0.00069813
----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)

Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = 5.3046422E-011
Shear Force, V2 = 5.0618734E-015
Shear Force, V3 = 22631.087
Axial Force, F = -28999.911
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 = 0.0032597
θu = θy + θp = 0.0032597

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.0012597 ((10-5), ASCE 41-17))
  My = 1.5083E+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 = 8.7645990E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 269.394
  d = 208.00
  ξy = 0.26113943
  A = 0.01034241
  B = 0.00628423
  with pt = 0.00379609
  pc = 0.00379609
  pv = 0.00257772
  N = 28999.911
  b = 3000.00
  δ'' = 0.20192308
Φy_comp = 2.5446036E-005
 with fc* (12.3, (ACI 440)) = 16.002
  fc = 16.00
  fl = 0.17503396
  b = 3000.00
  h = 250.00
  Ag = 750000.00
  From (12.9), ACI 440: ka = 0.00364754

ρg = pt + pc + pv = 0.0101699
rc = 40.00
Ae/Ac = 0.52524587
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
effective strain from (12.5) and (12.12), efe = 0.004
εfu = 0.01
Ef = 64828.00
Ec = 21019.039
ξy = 0.25891099
A = 0.01000033
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.39548208
lb = 300.00
ld = 758.5679
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 400.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

- 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') = -0.20911725
As = 0.00
As' = 6346.017
fy = 400.00
P = 28999.911
tw = 3000.00
lw = 250.00
fc = 16.00
- V/(tw*lw*fc^0.5) = 2.0319511E-020, NOTE: units in lb & in
- Confined Boundary: No
Boundary hoops spacing exceed 8db (s1 > 8*db or 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 = 83775.804
s1 = 150.00
Boundary Element 2:
Vw2 = 83775.804
s2 = 150.00
Grid Shear Force, Vw3 = 0.00
Concrete Shear Force, Vc = 125906.552
(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, db = 17.33333
Design Shear Force, V = 5.0618734E-015

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

Calculation No. 9

wall W1, Floor 1

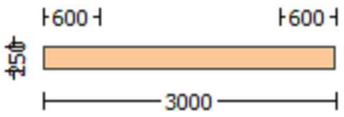
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

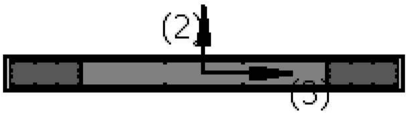
Analysis: Uniform +X

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, ASCE 41-17.
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

Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -9.6691022E-011
Shear Force, Va = -7.6985341E-015
EDGE -B-
Bending Moment, Mb = 7.0728943E-011
Shear Force, Vb = 7.6985341E-015
BOTH EDGES
Axial Force, F = -29773.887
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 = 312816.585
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 312816.585

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 = 124920.997
Mu/Vu-lw/2 = 12434.667 > 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 = 9.6691022E-011
Vu = 7.6985341E-015
Nu = 29773.887
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00

Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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

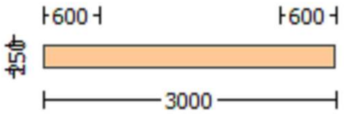
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

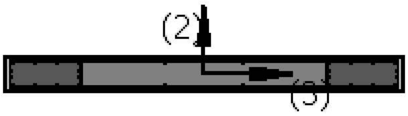
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029

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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), ρf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), ρf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00

ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062

λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).

This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai, as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813
----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)

Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Axial Force, F = -29773.887
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 = 0.02
from table 10-20: δu = 0.02
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20905275
As = 0.00
As' = 6346.017
fy = 400.00
P = 29773.887
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

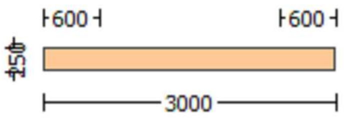
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

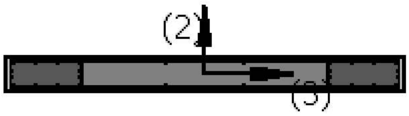
Analysis: Uniform +X

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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 1.0286E+008
Shear Force, Va = -34419.312
EDGE -B-
Bending Moment, Mb = 420173.225
Shear Force, Vb = 34419.312
BOTH EDGES
Axial Force, F = -29773.887
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 = 1.9920E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.9920E+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 = 613369.253
Mu/Vu-lw/2 = 1488.32 > 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 = 1.0286E+008
Vu = 34419.312
Nu = 29773.887
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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

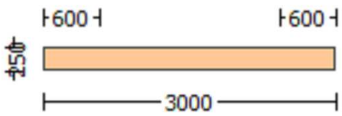
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

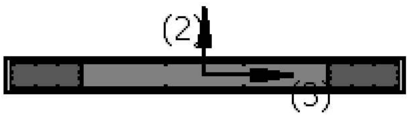
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029
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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00

fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00

h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712

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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00

ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712

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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00

From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00

sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813

----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = -9.6691022E-011
Shear Force, V2 = -7.6985341E-015
Shear Force, V3 = -34419.312
Axial Force, F = -29773.887
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 = 0.01626031
θu = θy + θp = 0.01626031

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00126031 ((10-5), ASCE 41-17))
My = 1.5091E+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 = 8.7656668E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 269.394
d = 208.00
ξy = 0.26122943
A = 0.01034702
B = 0.00628884
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 29773.887
b = 3000.00
δ" = 0.20192308
Φy_comp = 2.5442941E-005
with fc* (12.3, (ACI 440)) = 16.002
fc = 16.00
fl = 0.17503396
b = 3000.00
h = 250.00
Ag = 750000.00
From (12.9), ACI 440: ka = 0.00364754
ρg = pt + pc + pv = 0.0101699
rc = 40.00
Ae/Ac = 0.52524587
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
effective strain from (12.5) and (12.12), efe = 0.004
εfu = 0.01
Ef = 64828.00
Ec = 21019.039
ξy = 0.25894248
A = 0.0099958
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.39548208
lb = 300.00
ld = 758.5679
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 400.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

 - Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.015
with:
 - Condition i (shear wall and wall segments)
 - (As-As')*fy+P)/(tw*lw*fc') = -0.20905275
     As = 0.00
     As' = 6346.017
     fy = 400.00
     P = 29773.887
     tw = 3000.00
     lw = 250.00
     fc = 16.00
 - V/(tw*lw*fc^0.5) = 3.0903667E-020, NOTE: units in lb & in
 - Confined Boundary: No
   Boundary hoops spacing exceed 8db (s1 > 8*db or 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 = 83775.804
     s1 = 150.00
   Boundary Element 2:
     Vw2 = 83775.804
     s2 = 150.00
    Grid Shear Force, Vw3 = 0.00
    Concrete Shear Force, Vc = 124920.997
(The variables above have already been given in Shear control ratio calculation)
    Mean diameter of all bars, db = 17.33333
    Design Shear Force, V = 7.6985341E-015

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

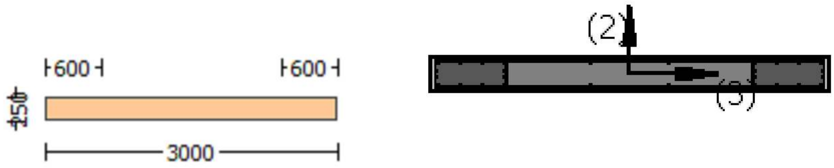
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

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: (d)
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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -9.6691022E-011
Shear Force, Va = -7.6985341E-015
EDGE -B-
Bending Moment, Mb = 7.0728943E-011
Shear Force, Vb = 7.6985341E-015
BOTH EDGES
Axial Force, F = -29773.887
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 = 314647.823
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 314647.823

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 = 126752.235
Mu/Vu-lw/2 = 9062.326 > 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 = 7.0728943E-011
Vu = 7.6985341E-015
Nu = 29773.887
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)

Calculation No. 14

wall W1, Floor 1

Limit State: Collapse Prevention (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 = 1.00406
Element Length, L = 3000.00

Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029
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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00

ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128

bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062

λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015

ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959

with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00

ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----

psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959

with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00

Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member

Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907

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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062

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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00

effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406

εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00

ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00

$\varepsilon y2 = 0.00120915$
$\varepsilon sh2 = 0.00467215$
ft2 = 348.235
fy2 = 290.1959
$\varepsilon su2 = 0.00579712$
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 = 0.31638566
$\varepsilon su2$ = 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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
$\varepsilon yv = 0.00120915$
$\varepsilon shv = 0.00467215$
ftv = 348.235
fyv = 290.1959
$\varepsilon suv = 0.00579712$
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80

ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047

ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00

εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804

Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 0.00069813

----

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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Axial Force, F = -29773.887
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 = 0.02
from table 10-20: δu = 0.02
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20905275
As = 0.00
As' = 6346.017
fy = 400.00
P = 29773.887
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

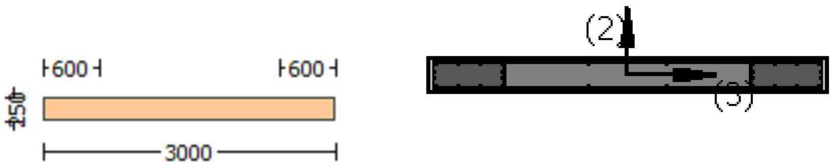
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

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: (d)
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, ASCE 41-17.
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 1.0286E+008
Shear Force, Va = -34419.312
EDGE -B-
Bending Moment, Mb = 420173.225
Shear Force, Vb = 34419.312
BOTH EDGES
Axial Force, F = -29773.887
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 = 1.9920E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vn < 0.83*fc'^0.5*h*d = 1.9920E+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 = 653954.777
Mu/Vu-lw/2 = -1487.793 <= 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 = 420173.225
Vu = 34419.312
Nu = 29773.887
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633

s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)

Calculation No. 16

wall W1, Floor 1

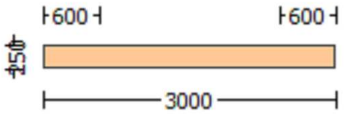
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

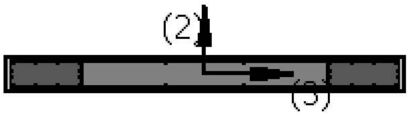
Analysis: Uniform +X

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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 6.3108872E-029
EDGE -B-
Shear Force, Vb = -6.3108872E-029

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 = 1.01783
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 2.0275E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0413E+009
Mu1+ = 2.8453E+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- = 3.0413E+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-) = 3.0413E+009
Mu2+ = 2.8453E+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- = 3.0413E+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 = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00

ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2735554E-006
Mu = 2.8453E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566

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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
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) = 0.13770595
Mu = MRc (4.14) = 2.8453E+009
φu = φsu (4.1) = 2.2735554E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2880917E-006
Mu = 3.0413E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07029503
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07029503
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.01510726
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 16.06499

εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09344146
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09344146
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02008172
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14318411
Mu = MRc (4.14) = 3.0413E+009
φu = φsu (4.1) = 2.2880917E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 1.9920E+006

Calculation of Shear Strength at edge 1, Vr1 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 1.9920E+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 = 2.8012401E-010
Vu = 6.3108872E-029
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 854513.202
Vs1 = 201061.93 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 201061.93 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 150.00
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) = 1.5581E+006
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 2957.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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 = 1.00406
Element Length, L = 3000.00
Primary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
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 = 0.14054053
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 118250.575
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.7738E+008
Mu1+ = 1.4516E+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- = 1.7738E+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-) = 1.7738E+008
Mu2+ = 1.4516E+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- = 1.7738E+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 = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*psh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
$\Sigma bi2\_1$ = 655400.00
ase2 = 0.00
sh_2 = 150.00
bo_2 = 190.00
ho_2 = 540.00
$\Sigma bi2\_2$ = 655400.00

ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.4223799E-005
Mu = 1.4516E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
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) = 16.06499
εcc (5A.5, TBDY) = 0.00204062
λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
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) = 0.18563201
Mu = MRc (4.14) = 1.4516E+008
φu = φsu (4.1) = 3.4223799E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 3.5153739E-005
Mu = 1.7738E+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), TBDY) = ase*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.00
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.00
af = 0.00
b = 250.00
h = 3000.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 636.1644

ωfy = 0.00
af = 0.00
b = 3000.00
h = 250.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.00067733
bw = 3000.00
effective stress from (A.35), ff,e = 944.3987

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 150.00
bo_1 = 190.00
ho_1 = 540.00
Σbi2_1 = 655400.00
ase2 = 0.00
sh_2 = 150.00
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) = 0.00069813
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x = ps1,x+ps2,x+ps3,x = 0.00356047
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00083776
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00083776
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 = 0.00069813
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.00034907
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.00034907
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 = 150.00
s_2 = 150.00
s_3 = 200.00
fywe = 500.00
fce = 16.00
From ((5.A5), TBDY), TBDY: εcc = 0.00204062
λc = confinement factor = 1.00406
εy1 = 0.00120915
εsh1 = 0.00467215
ft1 = 348.235
fy1 = 290.1959
εsu1 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs1 = fs = 290.1959
with Es1 = Es = 200000.00
εy2 = 0.00120915
εsh2 = 0.00467215
ft2 = 348.235
fy2 = 290.1959
εsu2 = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fs2 = fs = 290.1959
with Es2 = Es = 200000.00
εyv = 0.00120915
εshv = 0.00467215
ftv = 348.235
fyv = 290.1959
εsuv = 0.00579712
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 = 0.31638566
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, ASCE 41-17.
with fsv = fs = 290.1959
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06885062
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06885062
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04675268
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 16.06499
εcc (5A.5, TBDY) = 0.00204062

λc = confinement factor = 1.00406
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08209659
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08209659
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05574729
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20717489
Mu = MRc (4.14) = 1.7738E+008
φu = φsu (4.1) = 3.5153739E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.31638566
lb = 300.00
ld = 948.2098
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 500.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 841398.394

Calculation of Shear Strength at edge 1, Vr1 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 1.5943E+006
bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 841398.394
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 = 1.9099438E-011
Vu = 0.00
Nu = 27514.027
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 83775.804
Vs1 = 41887.902 is calculated for pseudo-Column 1, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs1 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vs2 = 41887.902 is calculated for pseudo-Column 2, with:
d = 200.00
Av = 157079.633
s = 150.00
fy = 400.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
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) = 109599.773
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cota)sina which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).

This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 208.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
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: (d)
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 = 0.00069813
----
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 = 0.00034907
h1 = 250.00
s1 = 150.00
total area of hoops perpedicular to shear axis, As1 = 157.0796
(pseudo-col.2 ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.00034907
h2 = 250.00
s2 = 150.00
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
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)

Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = 7.0728943E-011
Shear Force, V2 = 7.6985341E-015
Shear Force, V3 = 34419.312
Axial Force, F = -29773.887
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 = 0.01626031
θu = θy + θp = 0.01626031

- Calculation of θy -

θy = (My*lp)/(EI)Eff = 0.00126031 ((10-5), ASCE 41-17))
My = 1.5091E+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 = 8.7656668E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 269.394
d = 208.00
ξy = 0.26122943
A = 0.01034702
B = 0.00628884
with pt = 0.00379609
pc = 0.00379609
pv = 0.00257772
N = 29773.887
b = 3000.00
δ'' = 0.20192308
Φy_comp = 2.5442941E-005
with fc* (12.3, (ACI 440)) = 16.002
fc = 16.00
fl = 0.17503396
b = 3000.00
h = 250.00
Ag = 750000.00
From (12.9), ACI 440: ka = 0.00364754

ρg = pt + pc + pv = 0.0101699
rc = 40.00
Ae/Ac = 0.52524587
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
effective strain from (12.5) and (12.12), efe = 0.004
εfu = 0.01
Ef = 64828.00
Ec = 21019.039
ξy = 0.25894248
A = 0.0099958
B = 0.00611172
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.39548208
lb = 300.00
ld = 758.5679
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 16.85714
Mean strength value of all re-bars: fy = 400.00
ψt = 1.00
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.24399
n = 28.00

- Calculation of θp -

Considering wall controlled by flexure (shear control ratio <= 1),
from table 10-19: θp = 0.015
with:
- Condition i (shear wall and wall segments)
- (As-As')*fy+P)/(tw*lw*fc') = -0.20905275
As = 0.00
As' = 6346.017
fy = 400.00
P = 29773.887
tw = 3000.00
lw = 250.00
fc = 16.00
- V/(tw*lw*fc^0.5) = 3.0903667E-020, NOTE: units in lb & in
- Confined Boundary: No
Boundary hoops spacing exceed 8db (s1 > 8*db or 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 = 83775.804
s1 = 150.00
Boundary Element 2:
Vw2 = 83775.804
s2 = 150.00
Grid Shear Force, Vw3 = 0.00
Concrete Shear Force, Vc = 126752.235
(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, db = 17.33333
Design Shear Force, V = 7.6985341E-015

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