Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

beam B1, Floor 1

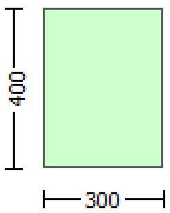
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

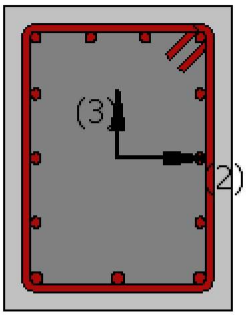
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -6.3267464E-011
Shear Force, Va = -6.0183003E-014
EDGE -B-
Bending Moment, Mb = -4.8101563E-011
Shear Force, Vb = 6.0183003E-014
BOTH EDGES
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.40

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 171047.78
Vn ((22.5.1.1), ACI 318-14) = 171047.78

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 (22.5.5.1), ACI 318-14: Vc = 76800.00
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 6.3267464E-011
Vu = 6.0183003E-014
From (11.5.4.8), ACI 318-14: Vs = 94247.78
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 2

beam B1, Floor 1

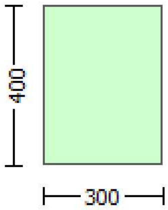
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

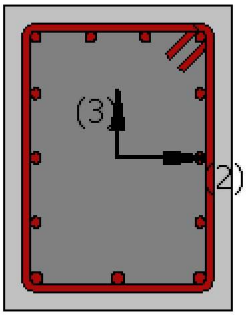
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00

psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----

psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101

and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982

No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00

d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00

----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00

fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537

Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00

----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00

fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00

From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217

εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
$\varphi u = \varphi su$ (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012

Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 6.8260E+006
Shear Force, V2 = -6.0183003E-014
Shear Force, V3 = -4669.742
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 15.20

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00827915
θu = θy + θp = 0.00827915

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00327915 ((4.29),Biskinis Phd))
My = 8.7218E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1461.749
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2960E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.2910708E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 357.00
ξy = 0.28429351
A = 0.02002644
B = 0.01114881
with pt = 0.00850665
pc = 0.00862398
pv = 0.00287466
N = 612.5536
b = 300.00
δ'' = 0.11764706
Φy_comp = 2.1691827E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.28409741
A = 0.01999229
B = 0.01112766
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.39885187
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 6.0440428E-005

- Stirrup Spacing <= d/2
  d = 357.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 186169.943,already given in calculation of shear control ratio
  design Shear = 4669.742
- (ρ-ρ')/ρbal = -0.17558466
  ρ = Aslt/(bw*d) = 0.00850665
    Tension Reinf Area: Aslt = 911.0619
  ρ' = Aslc/(bw*d) = 0.01149864
    Compression Reinf Area: Aslc = 1231.504
  From (B-1), ACI 318-11: ρbal = 0.01704017
    fc = 33.00
    fy = 555.56
    From 10.2.7.3, ACI 318-11: β1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
      εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.09140494, NOTE: units in lb & in
    bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 3

beam B1, Floor 1

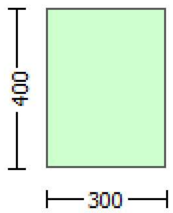
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

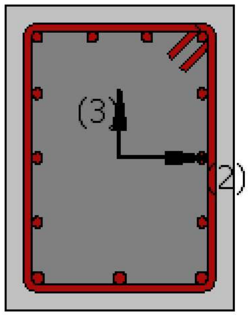
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3

Integration Section: (a)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.8260E+006
Shear Force, Va = -4669.742
EDGE -B-
Bending Moment, Mb = 6.9394E+006
Shear Force, Vb = 10211.784
BOTH EDGES
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 247742.188
Vn ((22.5.1.1), ACI 318-14) = 247742.188

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 (22.5.5.1), ACI 318-14: Vc = 80190.58
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.21891587
Mu = 6.8260E+006
Vu = 4669.742
From (11.5.4.8), ACI 318-14: Vs = 167551.608
Av = 157079.633
fy = 500.00

s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 4

beam B1, Floor 1

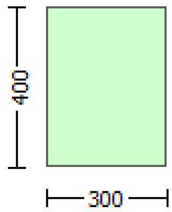
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

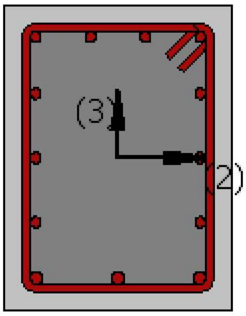
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00

Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005

N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406

εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,

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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688

ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633

fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----

Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007

----

with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00

psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----

psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626

and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982

No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00

d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00

----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00

fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -6.3267464E-011
Shear Force, V2 = -6.0183003E-014
Shear Force, V3 = -4669.742
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141

-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.40

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00756399
θu = θy + θp = 0.00756399

- Calculation of θy -

θy = (My*Ls/3)/Eleff = 0.00256399 ((4.29),Biskinis Phd))
My = 6.0620E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 7.2898E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.4477525E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 258.00
ξy = 0.29643893
A = 0.02078325
B = 0.01209248
with pt = 0.00791487
pc = 0.00791487
pv = 0.00493157
N = 612.5536
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.8784108E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.29625053
A = 0.02074781
B = 0.01207052
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005

with:
- Condition iv occured
  Beam controlled by inadequate embedment into beam-column joint:
  (lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
  Beam controlled by flexure: Vp/Vo <= 1
  shear control ratio Vp/Vo = 0.38581165
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = -1.1243915E-021
- Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 139627.457,already given in calculation of shear control ratio
  design Shear = 6.0183003E-014
- (ρ-ρ')/ρbal = -0.18222013
  ρ = Aslt/(bw*d) = 0.00882812
  Tension Reinf Area: Aslt = 911.0619
  ρ' = Aslc/(bw*d) = 0.01193318
  Compression Reinf Area: Aslc = 1231.504
  From (B-1), ACI 318-11: ρbal = 0.01704017
  fc = 33.00
  fy = 555.56
  From 10.2.7.3, ACI 318-11: β1 = 0.65
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
  εy = 0.0027778
- V/(bw*d*fc^0.5) = 1.2225325E-018, NOTE: units in lb & in
  bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 5

beam B1, Floor 1

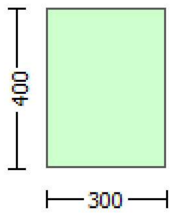
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

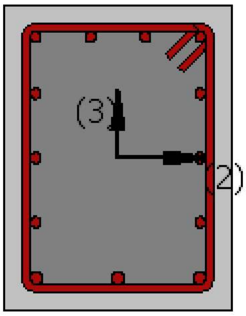
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -6.3267464E-011
Shear Force, Va = -6.0183003E-014
EDGE -B-
Bending Moment, Mb = -4.8101563E-011
Shear Force, Vb = 6.0183003E-014
BOTH EDGES
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.40

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 171047.78
Vn ((22.5.1.1), ACI 318-14) = 171047.78

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 (22.5.5.1), ACI 318-14: Vc = 76800.00
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00962113
As (tension reinf.) = 923.6282
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.8101563E-011
Vu = 6.0183003E-014
From (11.5.4.8), ACI 318-14: Vs = 94247.78
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 6

beam B1, Floor 1

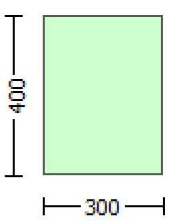
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

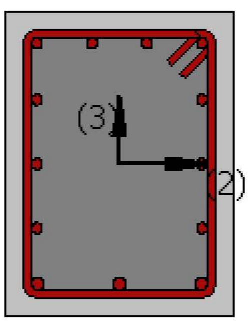
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3

(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2

with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406

εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,

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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444

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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005

Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00

εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----

with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528

ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00

d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595

εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00

v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619

bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel

With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 6.9394E+006
Shear Force, V2 = 6.0183003E-014
Shear Force, V3 = 10211.784
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 923.6282
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 14.00

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00654641
θu = θy + θp = 0.00654641

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00154641 ((4.29),Biskinis Phd))
My = 8.8475E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 679.5492
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2960E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.2905043E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 358.00
ξy = 0.28621627
A = 0.0199705
B = 0.01124535
with pt = 0.00859989
pc = 0.00848289
pv = 0.00286663
N = 612.5536
b = 300.00
δ'' = 0.12011173
Φy_comp = 2.1485644E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.28602252
A = 0.01993644
B = 0.01122426
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258

lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.39885187
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 2.7479450E-005
- Stirrup Spacing <= d/2
d = 358.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 186169.943,already given in calculation of shear control ratio
design Shear = 10211.784
- (ρ-ρ')/ρbal = -0.16136132
ρ = Aslt/(bw*d) = 0.00859989
Tension Reinf Area: Aslt = 923.6282
ρ' = Aslc/(bw*d) = 0.01134952
Compression Reinf Area: Aslc = 1218.938
From (B-1), ACI 318-11: ρbal = 0.01704017
fc = 33.00
fy = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.19932585, NOTE: units in lb & in
bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 7

beam B1, Floor 1

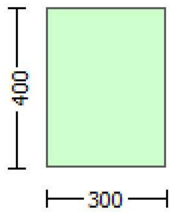
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

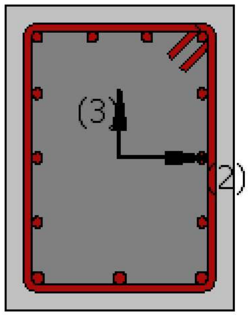
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.8260E+006
Shear Force, Va = -4669.742
EDGE -B-
Bending Moment, Mb = 6.9394E+006
Shear Force, Vb = 10211.784
BOTH EDGES
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 923.6282
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 14.00

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 251745.536
Vn ((22.5.1.1), ACI 318-14) = 251745.536

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 (22.5.5.1), ACI 318-14: Vc = 84193.928
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00962113
As (tension reinf.) = 923.6282
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.47090045
Mu = 6.9394E+006
Vu = 10211.784
From (11.5.4.8), ACI 318-14: Vs = 167551.608
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 8

beam B1, Floor 1

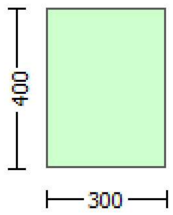
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

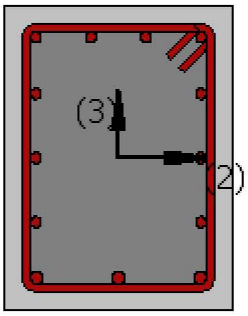
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595

εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406

lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007

Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595

with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45

ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853

εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80

ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114

fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00

Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -4.8101563E-011
Shear Force, V2 = 6.0183003E-014
Shear Force, V3 = 10211.784
Axial Force, F = -612.5536
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.40

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00756399
θu = θy + θp = 0.00756399

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00256399 ((4.29),Biskinis Phd))
My = 6.0620E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.2898E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.4477525E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 258.00
ξy = 0.29643893
A = 0.02078325
B = 0.01209248
with pt = 0.00791487
pc = 0.00791487

$\rho v = 0.00493157$
N = 612.5536
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.8784108E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.29625053
A = 0.02074781
B = 0.01207052
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.38581165
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = -1.6736352E-021
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 139627.457,already given in calculation of shear control ratio
design Shear = 6.0183003E-014
- (ρ-ρ')/ρbal = -0.16792835
ρ = Aslt/(bw*d) = 0.00894989
Tension Reinf Area: Aslt = 923.6282
ρ' = Aslc/(bw*d) = 0.01181141
Compression Reinf Area: Aslc = 1218.938
From (B-1), ACI 318-11: ρbal = 0.01704017
fc = 33.00
fy = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 1.2225325E-018, NOTE: units in lb & in
bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1

At local axis: 3
Integration Section: (b)

Calculation No. 9

beam B1, Floor 1

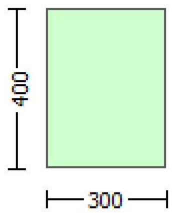
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

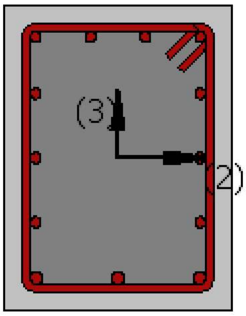
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)

Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -7.4560473E-011
Shear Force, Va = -7.2286192E-014
EDGE -B-
Bending Moment, Mb = -5.9205937E-011
Shear Force, Vb = 7.2286192E-014
BOTH EDGES
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.40

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 171047.78
Vn ((22.5.1.1), ACI 318-14) = 171047.78

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 (22.5.5.1), ACI 318-14: Vc = 76800.00
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 7.4560473E-011
Vu = 7.2286192E-014
From (11.5.4.8), ACI 318-14: Vs = 94247.78
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 10

beam B1, Floor 1

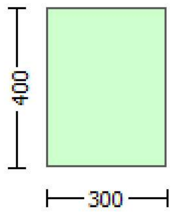
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

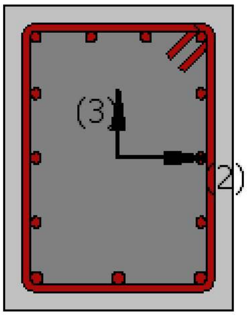
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-

Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799

Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167

λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00

bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----

s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189

Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45

fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00

Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528

ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007

$\varphi u = \varphi su$ (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu^* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
$\Sigma bi2$ = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
$\varepsilon y1$ = 0.00104853
$\varepsilon sh1$ = 0.00335528
ft1 = 349.5114
fy1 = 291.2595

εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406

lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 8.2483E+006
Shear Force, V2 = -7.2286192E-014
Shear Force, V3 = -6236.526
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 15.20

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.02296739
θu = θy + θp = 0.02296739

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00296739 ((4.29),Biskinis Phd))
My = 8.7231E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1322.575
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2960E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.2913486E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 357.00
ξy = 0.28433109
A = 0.02002951
B = 0.01115188
with pt = 0.00850665
pc = 0.00862398
pv = 0.00287466
N = 701.3709
b = 300.00
δ'' = 0.11764706
Φy_comp = 2.1691126E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.28410658
A = 0.0199904
B = 0.01112766
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.02
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.39885187
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 6.9139455E-005
- Stirrup Spacing <= d/2
d = 357.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 186169.943,already given in calculation of shear control ratio
design Shear = 6236.526
- (ρ-ρ')/ρbal = -0.17558466
ρ = Aslt/(bw*d) = 0.00850665

Tension Reinf Area: Aslt = 911.0619
ρ' = Aslc/(bw*d) = 0.01149864
Compression Reinf Area: Aslc = 1231.504
From (B-1), ACI 318-11: ρbal = 0.01704017
fc = 33.00
fy = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.12207297, NOTE: units in lb & in
bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 11

beam B1, Floor 1

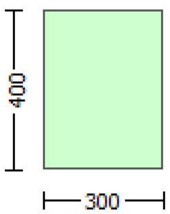
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

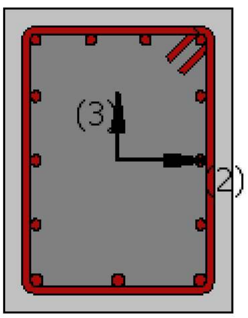
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 8.2483E+006
Shear Force, Va = -6236.526
EDGE -B-
Bending Moment, Mb = 8.4157E+006
Shear Force, Vb = 11778.568
BOTH EDGES
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 248098.976
Vn ((22.5.1.1), ACI 318-14) = 248098.976

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 (22.5.5.1), ACI 318-14: Vc = 80547.368
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.24195217
Mu = 8.2483E+006
Vu = 6236.526
From (11.5.4.8), ACI 318-14: Vs = 167551.608
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 12

beam B1, Floor 1

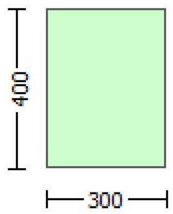
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

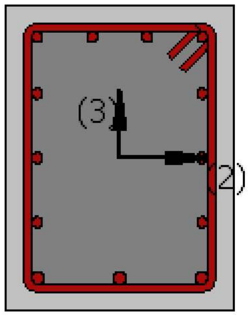
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)

Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608

bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00

Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799

----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066

Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:

b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-

Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799

Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167

λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00

bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----

s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517

Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45

fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00

d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -7.4560473E-011
Shear Force, V2 = -7.2286192E-014
Shear Force, V3 = -6236.526
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.40

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0225644
θu = θy + θp = 0.0225644

- Calculation of θy -

θy = (My*Ls/3)/Eleff = 0.0025644 ((4.29),Biskinis Phd))
My = 6.0629E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 7.2898E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.4481424E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 258.00
ξy = 0.29647576
A = 0.02078644
B = 0.01209566
with pt = 0.00791487
pc = 0.00791487
pv = 0.00493157
N = 701.3709
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.8783181E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.29626007
A = 0.02074585
B = 0.01207052
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.02
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.38581165
- Transverse Reinforcement: NC

- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
    θ = -1.3173849E-021
- Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 139627.457,already given in calculation of shear control ratio
  design Shear = 7.2286192E-014
- (ρ-ρ')/ρbal = -0.18222013
  ρ = Aslt/(bw*d) = 0.00882812
    Tension Reinf Area: Aslt = 911.0619
  ρ' = Aslc/(bw*d) = 0.01193318
    Compression Reinf Area: Aslc = 1231.504
  From (B-1), ACI 318-11: ρbal = 0.01704017
    fc = 33.00
    fy = 555.56
    From 10.2.7.3, ACI 318-11: β1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
      εy = 0.0027778
- V/(bw*d*fc^0.5) = 1.4683917E-018, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 13

beam B1, Floor 1

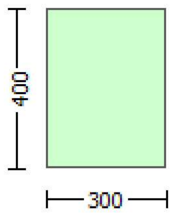
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

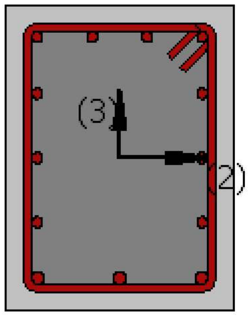
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -7.4560473E-011
Shear Force, Va = -7.2286192E-014
EDGE -B-
Bending Moment, Mb = -5.9205937E-011
Shear Force, Vb = 7.2286192E-014
BOTH EDGES
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.40

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 171047.78
Vn ((22.5.1.1), ACI 318-14) = 171047.78

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 (22.5.5.1), ACI 318-14: Vc = 76800.00
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00962113
As (tension reinf.) = 923.6282
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 5.9205937E-011

Vu = 7.2286192E-014
From (11.5.4.8), ACI 318-14: Vs = 94247.78
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 14

beam B1, Floor 1

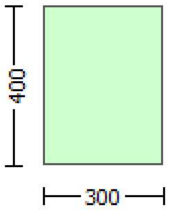
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

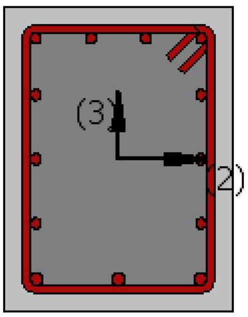
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----

with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528

ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00

d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595

εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00

v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537

fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00

Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars

Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688

ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608

bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00

Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799

----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 8.4157E+006
Shear Force, V2 = 7.2286192E-014
Shear Force, V3 = 11778.568
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 923.6282
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 14.00

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.02162617
θu = θy + θp = 0.02162617

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00162617 ((4.29),Biskinis Phd))
My = 8.8489E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 714.4901
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2960E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.2907804E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 358.00
ξy = 0.28625352
A = 0.01997356
B = 0.01124841
with pt = 0.00859989
pc = 0.00848289
pv = 0.00286663
N = 701.3709
b = 300.00
δ" = 0.12011173
Φy_comp = 2.1484954E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.2860317
A = 0.01993456
B = 0.01122426
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00
ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.02
with:
- Condition iv occured
  Beam controlled by inadequate embedment into beam-column joint:
  (lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
  Beam controlled by flexure: Vp/Vo <= 1
  shear control ratio Vp/Vo = 0.39885187
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 3.7293501E-005
- Stirrup Spacing <= d/2
  d = 358.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 186169.943,already given in calculation of shear control ratio
  design Shear = 11778.568
- (ρ-ρ')/ρbal = -0.16136132
  ρ = Aslt/(bw*d) = 0.00859989
  Tension Reinf Area: Aslt = 923.6282
  ρ' = Aslc/(bw*d) = 0.01134952
  Compression Reinf Area: Aslc = 1218.938
  From (B-1), ACI 318-11: ρbal = 0.01704017
  fc = 33.00
  fy = 555.56
  From 10.2.7.3, ACI 318-11: β1 = 0.65
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
  εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.22990821, NOTE: units in lb & in
  bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 15

beam B1, Floor 1

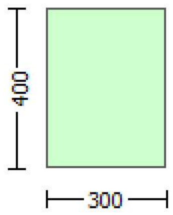
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

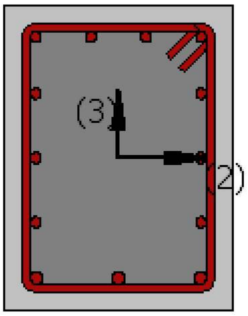
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

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:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 8.2483E+006
Shear Force, Va = -6236.526
EDGE -B-
Bending Moment, Mb = 8.4157E+006
Shear Force, Vb = 11778.568
BOTH EDGES
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 923.6282
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 14.00

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 251383.949
Vn ((22.5.1.1), ACI 318-14) = 251383.949

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 (22.5.5.1), ACI 318-14: Vc = 83832.34
λ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00962113
As (tension reinf.) = 923.6282
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.44787184
Mu = 8.4157E+006
Vu = 11778.568
From (11.5.4.8), ACI 318-14: Vs = 167551.608
Av = 157079.633
fy = 500.00
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 318865.838

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 16

beam B1, Floor 1

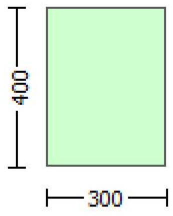
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

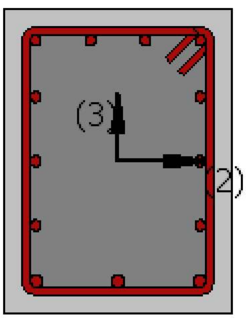
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)

Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2771.022
EDGE -B-
Shear Force, Vb = 2771.021
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 923.6282
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.39885187
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 115624.954
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.0444E+008
Mu1+ = 1.0296E+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- = 1.0444E+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-) = 1.0434E+008
Mu2+ = 1.0305E+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- = 1.0434E+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
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 2771.022, is the shear force acting at edge 1 for the the static loading combination
V2 = 2771.021, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2093195E-005
Mu = 1.0296E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07508005
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07611563
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10246016
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1038734
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22282326
Mu = MRc (4.14) = 1.0296E+008
φu = φsu (4.1) = 1.2093195E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2082259E-005
Mu = 1.0444E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07590302
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07487033
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10355671
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10214778
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22429266
Mu = MRc (4.14) = 1.0444E+008
φu = φsu (4.1) = 1.2082259E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2065709E-005
Mu = 1.0305E+008
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 5.3821384E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07487033
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07590302
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02530101
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10214778
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10355671
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0345189
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22322862
Mu = MRc (4.14) = 1.0305E+008
φu = φsu (4.1) = 1.2065709E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2109886E-005
Mu = 1.0434E+008
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 5.3972144E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07611563
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07508005
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02537188
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1038734
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10246016
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03462447
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22389443
Mu = MRc (4.14) = 1.0434E+008
φu = φsu (4.1) = 1.2109886E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 289894.477

Calculation of Shear Strength at edge 1, Vr1 = 289894.477

Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71454.459
Vu = 2771.022
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 289894.477
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 103724.534
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 71455.367
Vu = 2771.021
From (11.5.4.8), ACI 318-14: Vs = 186169.943
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
New material: Steel Strength, fs = 1.25*fsm = 694.45
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06217
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -2.7041243E-015
EDGE -B-
Shear Force, Vb = 2.7041243E-015
BOTH EDGES
Axial Force, F = -190.7537
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 911.0619
-Compression: Aslc = 1231.504
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.38581165
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 74445.088
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.8862E+007
Mu1+ = 6.8862E+007, 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- = 6.8862E+007, 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-) = 6.8862E+007
Mu2+ = 6.8862E+007, 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- = 6.8862E+007, 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
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = -2.7041243E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.7041243E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007

----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853

εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:

b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114

fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00

d' = 42.00
v = 5.6011789E-005
N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.7004869E-005
Mu = 6.8862E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 5.6011789E-005

N = 190.7537
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00721688
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00721688
ωwe (5.4c) = 0.00863449
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
----
psh,x (5.4d) = 0.00349066
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 300.00
----
psh,y (5.4d) = 0.00261799
Ash = Astir*ns = 78.53982
No stirups, ns = 2.00
bk = 400.00
----
s = 150.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00262167
λc = confinement factor = 1.06217
εy1 = 0.00104853
εsh1 = 0.00335528
ft1 = 349.5114
fy1 = 291.2595
εsu1 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
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 = 291.2595
with Es1 = Es = 200000.00
εy2 = 0.00104853
εsh2 = 0.00335528
ft2 = 349.5114
fy2 = 291.2595
εsu2 = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
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 = 291.2595
with Es2 = Es = 200000.00
εyv = 0.00104853
εshv = 0.00335528
ftv = 349.5114
fyv = 291.2595
εsuv = 0.00335528
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.19435406
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
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 = 291.2595
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06985696
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06985696
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04352626
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 35.05152
εcc (5A.5, TBDY) = 0.00262167
λc = confinement factor = 1.06217
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09299842
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09299842
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05794517
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23522079
Mu = MRc (4.14) = 6.8862E+007
φu = φsu (4.1) = 1.7004869E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.19435406
lb = 300.00
ld = 1543.575
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 694.45
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 192957.075

Calculation of Shear Strength at edge 1, Vr1 = 192957.075
Vr1 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00

d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.6361865E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

Calculation of Shear Strength at edge 2, Vr2 = 192957.075
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 (22.5.5.1), ACI 318-14: Vc = 88236.482
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00949023
As (tension reinf.) = 911.0619
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6338743E-012
Vu = 2.7041243E-015
From (11.5.4.8), ACI 318-14: Vs = 104720.593
Av = 157079.633
fy = 555.56
s = 150.00
Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.75
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 366348.956

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)

Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -5.9205937E-011
Shear Force, V2 = 7.2286192E-014
Shear Force, V3 = 11778.568
Axial Force, F = -701.3709
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 923.6282
-Compression: Aslc = 1218.938
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 816.8141
-Compression: Asl,com = 816.8141
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.40

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0225644
θu = θy + θp = 0.0225644

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.0025644 ((4.29),Biskinis Phd))
My = 6.0629E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.2898E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.4481424E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 270.3814
d = 258.00
ξy = 0.29647576
A = 0.02078644
B = 0.01209566
with pt = 0.00791487
pc = 0.00791487
pv = 0.00493157
N = 701.3709
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.8783181E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.29626007
A = 0.02074585
B = 0.01207052
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.24294258
lb = 300.00

ld = 1234.86
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
λ = 1
db = 14.46154
Mean strength value of all re-bars: fy = 555.56
ψt = 1.18462
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 3.22215
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.02
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.38581165
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, $\theta/\theta y$ < 2 (table 10-6, ASCE 41-17)
θ = -2.1161258E-021
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 139627.457,already given in calculation of shear control ratio
design Shear = 7.2286192E-014
- $(\rho-\rho')/\rho bal$ = -0.16792835
ρ = Aslt/(bw*d) = 0.00894989
Tension Reinf Area: Aslt = 923.6282
ρ' = Aslc/(bw*d) = 0.01181141
Compression Reinf Area: Aslc = 1218.938
From (B-1), ACI 318-11: ρbal = 0.01704017
fc = 33.00
fy = 555.56
From 10.2.7.3, ACI 318-11: $\beta 1$ = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 1.4683917E-018, NOTE: units in lb & in
bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
