Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

beam B1, Floor 1

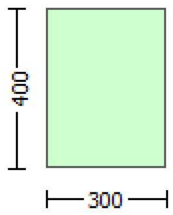
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

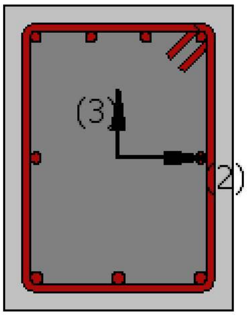
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96

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
Primary 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 = -4.6156525E-011
Shear Force, Va = -6.1565883E-014
EDGE -B-
Bending Moment, Mb = -6.7789134E-011
Shear Force, Vb = 6.1565883E-014
BOTH EDGES
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 162939.788
Vn ((22.5.1.1), ACI 318-14) = 162939.788

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 = 68692.008
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6156525E-011
Vu = 6.1565883E-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 <= 285202.276

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

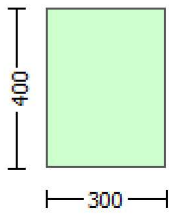
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

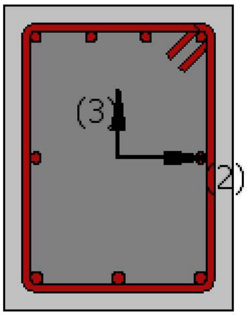
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007

----

with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007

----

with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822

and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00

d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00

fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631

Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007

----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00

From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372

εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011

Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 4.4888E+006
Shear Force, V2 = -6.1565883E-014
Shear Force, V3 = -2136.632
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 16.00

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00851739
θu = θy + θp = 0.00851739

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00351739 ((4.29),Biskinis Phd))
My = 6.2064E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 2100.884
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2357E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.1657138E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 357.00
ξy = 0.2572556
A = 0.01427189
B = 0.00793072
with pt = 0.00563199
pc = 0.00574932
pv = 0.00287466
N = 467.0578
b = 300.00
δ'' = 0.11764706
Φy_comp = 2.2857492E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.25706235
A = 0.01424557
B = 0.00791481
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- 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 = 0.25980235
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 4.8476007E-005

- Stirrup Spacing <= d/2
  d = 357.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 209439.51,already given in calculation of shear control ratio
  design Shear = 2136.632
- (ρ-ρ')/ρbal = -0.23034134
  ρ = Aslt/(bw*d) = 0.00563199
    Tension Reinf Area: Aslt = 603.1858
  ρ' = Aslc/(bw*d) = 0.00862398
    Compression Reinf Area: Aslc = 923.6282
  From (B-1), ACI 318-11: ρbal = 0.01298939
    fc = 30.00
    fy = 625.00
    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) = 0.48979592
      εy = 0.003125
- V/(bw*d*fc^0.5) = 0.04386345, 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

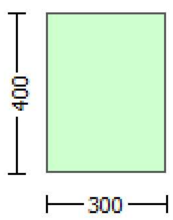
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

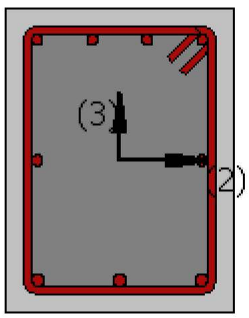
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 4.4888E+006
Shear Force, Va = -2136.632
EDGE -B-
Bending Moment, Mb = 4.5334E+006
Shear Force, Vb = 7617.16
BOTH EDGES
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 16.00

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 237805.497
Vn ((22.5.1.1), ACI 318-14) = 237805.497

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 = 70253.889
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.15231684
Mu = 4.4888E+006
Vu = 2136.632
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 <= 285202.276

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

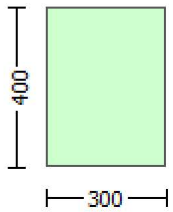
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

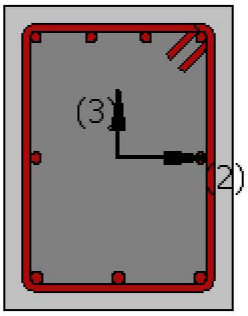
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00

Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005

N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423

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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475

ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633

fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044

$\omega2$ = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
$\omega1$ = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
$\omega2$ = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu^* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044

and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00

d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007

----

with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00

fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -4.6156525E-011
Shear Force, V2 = -6.1565883E-014
Shear Force, V3 = -2136.632
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938

-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00690173
θu = θy + θp = 0.00690173

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00190173 ((4.29),Biskinis Phd))
My = 4.2870E+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 = 6.9506E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.2581054E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 258.00
ξy = 0.26853262
A = 0.01481123
B = 0.0086181
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 467.0578
b = 400.00
δ'' = 0.1627907
Φy_comp = 3.0298407E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.2683464
A = 0.01478392
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- 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 = 0.24243061
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
   θ = -9.9457984E-022
 - Stirrup Spacing > d/2
   d = 258.00
   s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
   Vs = 157079.633,already given in calculation of shear control ratio
   design Shear = 6.1565883E-014
 - (ρ-ρ')/ρbal = -0.2390461
   ρ = Aslt/(bw*d) = 0.00584482
   Tension Reinf Area: Aslt = 603.1858
   ρ' = Aslc/(bw*d) = 0.00894989
   Compression Reinf Area: Aslc = 923.6282
   From (B-1), ACI 318-11: ρbal = 0.01298939
   fc = 30.00
   fy = 625.00
   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) = 0.48979592
   εy = 0.003125
 - V/(bw*d*fc^0.5) = 1.3116653E-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

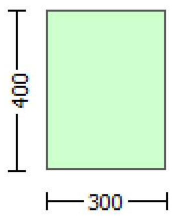
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

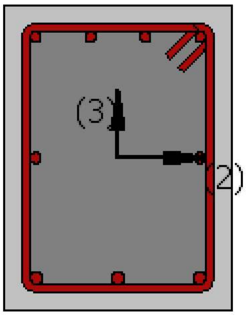
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -4.6156525E-011
Shear Force, Va = -6.1565883E-014
EDGE -B-
Bending Moment, Mb = -6.7789134E-011
Shear Force, Vb = 6.1565883E-014
BOTH EDGES
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 162939.788
Vn ((22.5.1.1), ACI 318-14) = 162939.788

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 = 68692.008
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00641409
As (tension reinf.) = 615.7522
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 6.7789134E-011
Vu = 6.1565883E-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 <= 285202.276

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

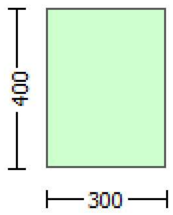
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

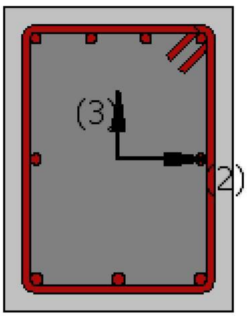
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423

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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96

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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005

Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00

$\varepsilon yv = 0.00094432$
$\varepsilon shv = 0.00302184$
ftv = 354.1217
fyv = 295.1014
$\varepsilon suv = 0.00302184$
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----

with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184

ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00

d = 258.00
d' = 42.00
v = 6.3230964E-005
  N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: εcu = 0.00763475
  ωwe (5.4c) = 0.0106851
    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 = 781.25
    fce = 30.00
  From ((5.A5), TBDY), TBDY: εcc = 0.00283722
    λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.16611423
  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 = 295.1014
   with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
  using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
  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 = 295.1014
   with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014

εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00

v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858

bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 4.5334E+006
Shear Force, V2 = 6.1565883E-014
Shear Force, V3 = 7617.16
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 615.7522
-Compression: Asl,com = 603.1858
-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 = 0.00601634
θu = θy + θp = 0.00601634

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00101634 ((4.29),Biskinis Phd))
My = 6.3303E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 595.1607
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2357E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.1672100E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 358.00
ξy = 0.25954478
A = 0.01423202
B = 0.00802919
with pt = 0.00573326
pc = 0.00561626
pv = 0.00286663
N = 467.0578
b = 300.00
δ" = 0.12011173
Φy_comp = 2.2592208E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.25935437
A = 0.01420578
B = 0.00801331
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279

lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- 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 = 0.25980235
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.2693156E-005
- Stirrup Spacing <= d/2
d = 358.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 209439.51,already given in calculation of shear control ratio
design Shear = 7617.16
- (ρ-ρ')/ρbal = -0.21168241
ρ = Aslt/(bw*d) = 0.00573326
Tension Reinf Area: Aslt = 615.7522
ρ' = Aslc/(bw*d) = 0.00848289
Compression Reinf Area: Aslc = 911.0619
From (B-1), ACI 318-11: ρbal = 0.01298939
fc = 30.00
fy = 625.00
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) = 0.48979592
εy = 0.003125
- V/(bw*d*fc^0.5) = 0.15593781, 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

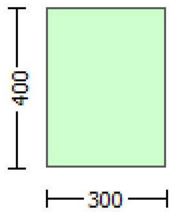
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

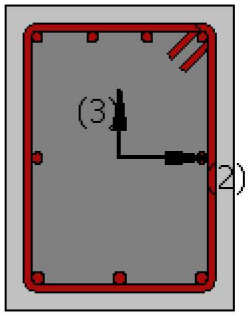
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 4.4888E+006
Shear Force, Va = -2136.632
EDGE -B-
Bending Moment, Mb = 4.5334E+006
Shear Force, Vb = 7617.16
BOTH EDGES
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 615.7522
-Compression: Asl,com = 603.1858
-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 = 241871.831
Vn ((22.5.1.1), ACI 318-14) = 241871.831

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 = 74320.222
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00641409
As (tension reinf.) = 615.7522
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.53766993
Mu = 4.5334E+006
Vu = 7617.16
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 <= 285202.276

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

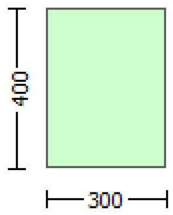
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

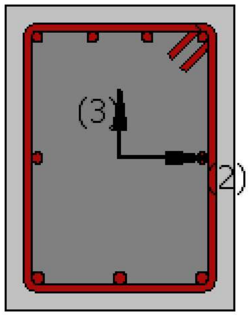
Analysis: Uniform +X

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014

εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423

lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986

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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007

Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014

with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25

ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432

$\varepsilon sh2$ = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
$\varepsilon su2$ = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
$\varepsilon su2$ = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and $\varepsilon y2$,$\varepsilon sh2$,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
$\varepsilon y1$,$\varepsilon sh1$,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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.
$\varepsilon y1$,$\varepsilon sh1$,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 295.1014
with Esv = Es = 200000.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80

ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217

fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00

Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -6.7789134E-011
Shear Force, V2 = 6.1565883E-014
Shear Force, V3 = 7617.16
Axial Force, F = -467.0578
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.00690173
θu = θy + θp = 0.00690173

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00190173 ((4.29),Biskinis Phd))
My = 4.2870E+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 = 6.9506E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.2581054E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 258.00
ξy = 0.26853262
A = 0.01481123
B = 0.0086181
with pt = 0.00493157
pc = 0.00493157

pv = 0.00493157
N = 467.0578
b = 400.00
δ'' = 0.1627907
Φy_comp = 3.0298407E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.2683464
A = 0.01478392
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- 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 = 0.24243061
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = -9.0140689E-022
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 157079.633,already given in calculation of shear control ratio
design Shear = 6.1565883E-014
- (ρ-ρ')/ρbal = -0.22029739
ρ = Aslt/(bw*d) = 0.00596659
Tension Reinf Area: Aslt = 615.7522
ρ' = Aslc/(bw*d) = 0.00882812
Compression Reinf Area: Aslc = 911.0619
From (B-1), ACI 318-11: ρbal = 0.01298939
fc = 30.00
fy = 625.00
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) = 0.48979592
εy = 0.003125
- V/(bw*d*fc^0.5) = 1.3116653E-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

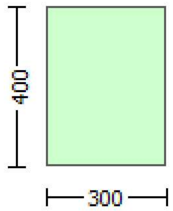
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

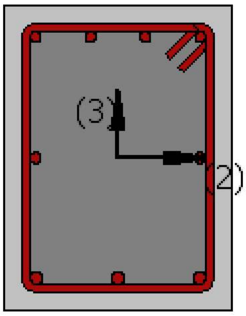
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: 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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -6.0461574E-011
Shear Force, Va = -8.3952889E-014
EDGE -B-
Bending Moment, Mb = -9.4928266E-011
Shear Force, Vb = 8.3952889E-014
BOTH EDGES
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 162939.788
Vn ((22.5.1.1), ACI 318-14) = 162939.788

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 = 68692.008
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 6.0461574E-011
Vu = 8.3952889E-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 <= 285202.276

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

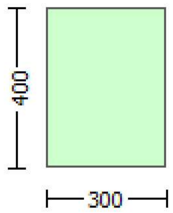
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

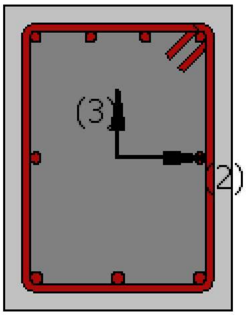
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: 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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-

Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722

λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166

Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25

fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00

Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184

ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007

$\varphi u = \varphi su$ (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014

εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423

lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 7.0496E+006
Shear Force, V2 = -8.3952889E-014
Shear Force, V3 = -4955.056
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 16.00

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.03238287
θu = θy + θp = 0.03238287

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00238287 ((4.29),Biskinis Phd))
My = 6.2088E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1422.701
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2357E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.1662963E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 357.00
ξy = 0.25733935
A = 0.01427723
B = 0.00793607
with pt = 0.00563199
pc = 0.00574932
pv = 0.00287466
N = 623.8427
b = 300.00
δ'' = 0.11764706
Φy_comp = 2.2855807E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.2570813
A = 0.01424208
B = 0.00791481
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- Calculation of θp -

From table 10-7: θp = 0.03
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 = 0.25980235
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 6.5144839E-005
- Stirrup Spacing <= d/2
d = 357.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 209439.51,already given in calculation of shear control ratio
design Shear = 4955.056
- (ρ-ρ')/ρbal = -0.23034134
ρ = Aslt/(bw*d) = 0.00563199

Tension Reinf Area: Aslt = 603.1858
ρ' = Aslc/(bw*d) = 0.00862398
Compression Reinf Area: Aslc = 923.6282
From (B-1), ACI 318-11: ρbal = 0.01298939
fc = 30.00
fy = 625.00
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) = 0.48979592
εy = 0.003125
- V/(bw*d*fc^0.5) = 0.10172359, 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

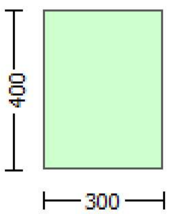
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

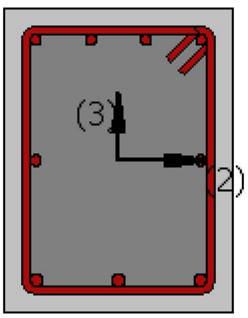
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: 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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 7.0496E+006
Shear Force, Va = -4955.056
EDGE -B-
Bending Moment, Mb = 7.1868E+006
Shear Force, Vb = 10435.585
BOTH EDGES
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 16.00

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 238550.025
Vn ((22.5.1.1), ACI 318-14) = 238550.025

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 = 70998.417
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.22492423
Mu = 7.0496E+006
Vu = 4955.056
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 <= 285202.276

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

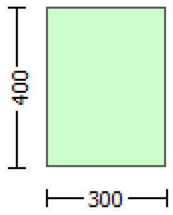
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

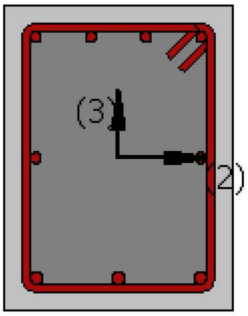
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: 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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00

$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
$\varphi u = \varphi su$ (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu^* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:

b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-

Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722

λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046

Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25

fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00

d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -6.0461574E-011
Shear Force, V2 = -8.3952889E-014
Shear Force, V3 = -4955.056
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0319025
θu = θy + θp = 0.0319025

 - Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.0019025 ((4.29),Biskinis Phd))
   My = 4.2887E+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 = 6.9506E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.2589205E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
      d = 258.00
      ξy = 0.26861476
      A = 0.01481678
      B = 0.00862364
       with pt = 0.00493157
           pc = 0.00493157
           pv = 0.00493157
           N = 623.8427
           b = 400.00
           δ" = 0.1627907
Φy_comp = 3.0296182E-005
 with fc = 30.00
      Ec = 25742.96
      ξy = 0.26836611
      A = 0.0147803
      B = 0.00860158
       with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
   Mean strength value of all re-bars: fy = 625.00
   ψt = 1.20
   ψs = 0.80
   ψe = 1.00
   cb = 25.00
   Ktr = 4.65421
     n = 9.00

 - Calculation of θp -

From table 10-7: θp = 0.03
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 = 0.24243061
 - Transverse Reinforcement: NC

- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = -1.5553622E-021
- Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 157079.633,already given in calculation of shear control ratio
  design Shear = 8.3952889E-014
- (ρ-ρ')/ρbal = -0.2390461
  ρ = Aslt/(bw*d) = 0.00584482
  Tension Reinf Area: Aslt = 603.1858
  ρ' = Aslc/(bw*d) = 0.00894989
  Compression Reinf Area: Aslc = 923.6282
  From (B-1), ACI 318-11: ρbal = 0.01298939
  fc = 30.00
  fy = 625.00
  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) = 0.48979592
  εy = 0.003125
- V/(bw*d*fc^0.5) = 1.7886219E-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

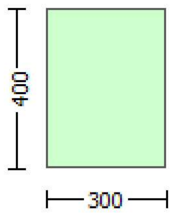
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

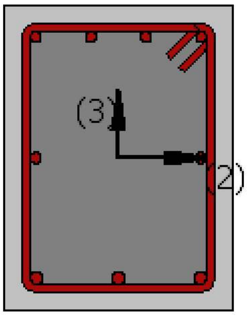
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: 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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -6.0461574E-011
Shear Force, Va = -8.3952889E-014
EDGE -B-
Bending Moment, Mb = -9.4928266E-011
Shear Force, Vb = 8.3952889E-014
BOTH EDGES
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 162939.788
Vn ((22.5.1.1), ACI 318-14) = 162939.788

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 = 68692.008
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00641409
As (tension reinf.) = 615.7522
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 9.4928266E-011

Vu = 8.3952889E-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 <= 285202.276

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

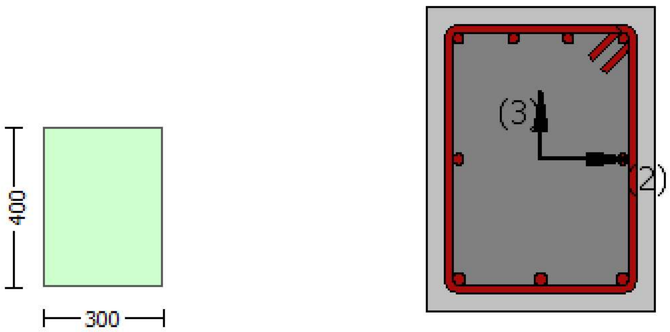
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)



Start Of Calculation of Shear Capacity ratio for element: 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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----

with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184

ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00

d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014

εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00

v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631

fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00

Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475

ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 7.1868E+006
Shear Force, V2 = 8.3952889E-014
Shear Force, V3 = 10435.585
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 615.7522
-Compression: Asl,com = 603.1858
-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 = 0.03117648
θu = θy + θp = 0.03117648

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00117648 ((4.29),Biskinis Phd))
My = 6.3327E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 688.6787
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.2357E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.1677880E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 358.00
ξy = 0.25962759
A = 0.01423735
B = 0.00803451
with pt = 0.00573326
pc = 0.00561626
pv = 0.00286663
N = 623.8427
b = 300.00
δ" = 0.12011173
Φy_comp = 2.2590556E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.25937333
A = 0.0142023
B = 0.00801331
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00
ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- Calculation of θp -

From table 10-7: θp = 0.03
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 = 0.25980235
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 3.1374812E-005
- Stirrup Spacing <= d/2
  d = 358.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 209439.51,already given in calculation of shear control ratio
  design Shear = 10435.585
- (ρ-ρ')/ρbal = -0.21168241
  ρ = Aslt/(bw*d) = 0.00573326
  Tension Reinf Area: Aslt = 615.7522
  ρ' = Aslc/(bw*d) = 0.00848289
  Compression Reinf Area: Aslc = 911.0619
  From (B-1), ACI 318-11: ρbal = 0.01298939
  fc = 30.00
  fy = 625.00
  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) = 0.48979592
  εy = 0.003125
- V/(bw*d*fc^0.5) = 0.21363633, 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

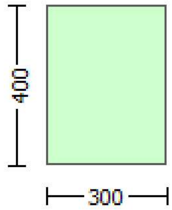
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

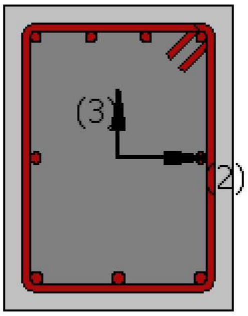
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: 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 Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = 7.0496E+006
Shear Force, Va = -4955.056
EDGE -B-
Bending Moment, Mb = 7.1868E+006
Shear Force, Vb = 10435.585
BOTH EDGES
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 615.7522
-Compression: Asl,com = 603.1858
-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 = 241107.556
Vn ((22.5.1.1), ACI 318-14) = 241107.556

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 = 73555.948
λ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00641409
As (tension reinf.) = 615.7522
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 0.46465789
Mu = 7.1868E+006
Vu = 10435.585
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 <= 285202.276

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

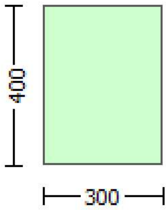
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

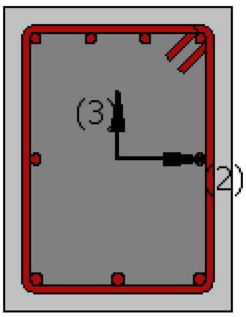
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: 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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = 2740.264
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 603.1858
-Compression: Asl,com = 615.7522
-Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.25980235
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 = 78934.152
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.0513E+007
Mu1+ = 6.9018E+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- = 7.0513E+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-) = 7.0446E+007
Mu2+ = 6.9083E+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- = 7.0446E+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 = 2740.264, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, 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 = 1.0920887E-005
Mu = 6.9018E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05540024
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05655441
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07560354
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07717861
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22492253
Mu = MRc (4.14) = 6.9018E+007
φu = φsu (4.1) = 1.0920887E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0912466E-005
Mu = 7.0513E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05639644
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05524549
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07694331
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07537304
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.2264911
Mu = MRc (4.14) = 7.0513E+007
φu = φsu (4.1) = 1.0912466E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0894946E-005
Mu = 6.9083E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 6.0758244E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05524549
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05639644
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02819822
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07537304
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07694331
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03847166
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22524724
Mu = MRc (4.14) = 6.9083E+007
φu = φsu (4.1) = 1.0894946E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.0938565E-005
Mu = 7.0446E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 6.0928436E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05655441
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05540024
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02827721
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07717861
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.07560354
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03858931
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.22617519
Mu = MRc (4.14) = 7.0446E+007
φu = φsu (4.1) = 1.0938565E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 303823.853

Calculation of Shear Strength at edge 1, Vr1 = 303823.853

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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 303823.853
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 = 94384.343
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 57790.039
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 209439.51
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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 = 781.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.08372
Element Length, L = 1850.00
Primary 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 = -2.2828243E-014
EDGE -B-
Shear Force, Vb = 2.2828243E-014
BOTH EDGES
Axial Force, F = -195.7631
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 603.1858
-Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.24243061
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 = 48956.415
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.5285E+007
Mu1+ = 4.5285E+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- = 4.5285E+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-) = 4.5285E+007
Mu2+ = 4.5285E+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- = 4.5285E+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 = -2.2828243E-014, is the shear force acting at edge 1 for the the static loading combination
V2 = 2.2828243E-014, 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 = 1.5314699E-005
Mu = 4.5285E+007

----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432

εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:

b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217

fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00

d' = 42.00
v = 6.3230964E-005
N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.5314699E-005
Mu = 4.5285E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 6.3230964E-005

N = 195.7631
fc = 30.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00763475
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00763475
ωwe (5.4c) = 0.0106851
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 = 781.25
fce = 30.00
From ((5.A5), TBDY), TBDY: εcc = 0.00283722
λc = confinement factor = 1.08372
εy1 = 0.00094432
εsh1 = 0.00302184
ft1 = 354.1217
fy1 = 295.1014
εsu1 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Es1 = Es = 200000.00
εy2 = 0.00094432
εsh2 = 0.00302184
ft2 = 354.1217
fy2 = 295.1014
εsu2 = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.16611423
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 = 295.1014
with Es2 = Es = 200000.00
εyv = 0.00094432
εshv = 0.00302184
ftv = 354.1217
fyv = 295.1014
εsuv = 0.00302184
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16611423
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 = 295.1014
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04851044
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04851044
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04851044
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 32.51165
εcc (5A.5, TBDY) = 0.00283722
λc = confinement factor = 1.08372
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06458046
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06458046
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06458046
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.23520848
Mu = MRc (4.14) = 4.5285E+007
φu = φsu (4.1) = 1.5314699E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.16611423
lb = 300.00
ld = 1805.986
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 = 14.66667
Mean strength value of all re-bars: fy = 781.25
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 201939.909

Calculation of Shear Strength at edge 1, Vr1 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00

d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.1403601E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

Calculation of Shear Strength at edge 2, Vr2 = 201939.909
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 = 84130.185
λ = 1 (normal-weight concrete)
fc' = 30.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00628319
As (tension reinf.) = 603.1858
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 2.0828592E-011
Vu = 2.2828243E-014
From (11.5.4.8), ACI 318-14: Vs = 117809.725
Av = 157079.633
fy = 625.00
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 <= 349300.025

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 Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
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
Primary 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 = -9.4928266E-011
Shear Force, V2 = 8.3952889E-014
Shear Force, V3 = 10435.585
Axial Force, F = -623.8427
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 615.7522
-Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 508.938
-Compression: Asl,com = 508.938
-Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0319025
θu = θy + θp = 0.0319025

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.0019025 ((4.29),Biskinis Phd))
My = 4.2887E+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 = 6.9506E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 7.2589205E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 273.9479
d = 258.00
ξy = 0.26861476
A = 0.01481678
B = 0.00862364
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 623.8427
b = 400.00
δ'' = 0.1627907
Φy_comp = 3.0296182E-005
with fc = 30.00
Ec = 25742.96
ξy = 0.26836611
A = 0.0147803
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.20764279
lb = 300.00

ld = 1444.789
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 = 14.66667
Mean strength value of all re-bars: fy = 625.00
ψt = 1.20
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 4.65421
n = 9.00

- Calculation of θp -

From table 10-7: θp = 0.03
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 = 0.24243061
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = -1.2482667E-021
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 157079.633,already given in calculation of shear control ratio
design Shear = 8.3952889E-014
- (ρ-ρ')/ρbal = -0.22029739
ρ = Aslt/(bw*d) = 0.00596659
Tension Reinf Area: Aslt = 615.7522
ρ' = Aslc/(bw*d) = 0.00882812
Compression Reinf Area: Aslc = 911.0619
From (B-1), ACI 318-11: ρbal = 0.01298939
fc = 30.00
fy = 625.00
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) = 0.48979592
εy = 0.003125
- V/(bw*d*fc^0.5) = 1.7886219E-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)
