Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

beam B1, Floor 1

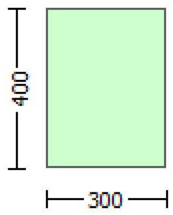
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

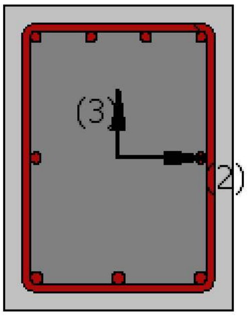
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





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

Constant Properties

Knowledge Factor, κ = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.1950118E-010
Shear Force, Va = -1.5070393E-013
EDGE -B-
Bending Moment, Mb = -1.5941812E-010
Shear Force, Vb = 1.5070393E-013
BOTH EDGES
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 117680.872
Vn ((22.5.1.1), ACI 318-14) = 136838.224

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 = 61440.00
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 1.1950118E-010
Vu = 1.5070393E-013
From (11.5.4.8), ACI 318-14: Vs = 75398.224
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

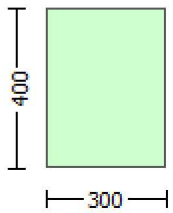
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

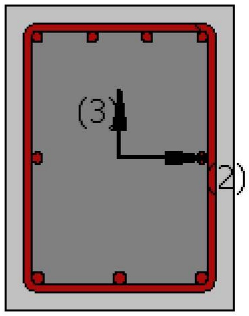
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





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

Constant Properties

Knowledge Factor, κ = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007

----

with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00

psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626

with $E_{sv} = E_s = 200000.00$
$\omega 1 = A_{sl,ten}/(b*d)*(fs1/fc) = 0.10285771$
$\omega 2 = A_{sl,com}/(b*d)*(fs2/fc) = 0.10500058$
$\omega v = A_{sl,mid}/(b*d)*(fsv/fc) = 0.05250029$
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
$\omega 1 = A_{sl,ten}/(b*d)*(fs1/fc) = 0.14036775$
$\omega 2 = A_{sl,com}/(b*d)*(fs2/fc) = 0.14329208$
$\omega v = A_{sl,mid}/(b*d)*(fsv/fc) = 0.07164604$
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799

Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----

psh,x (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 = 555.55

fce = 20.00

From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00

εy1 = 0.00152193

εsh1 = 0.00525983

ft1 = 438.3151

fy1 = 365.2626

εsu1 = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00

lo/lou,min = lb/ld = 0.38146798

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 = 365.2626

with Es1 = Es = 200000.00

εy2 = 0.00152193

εsh2 = 0.00525983

ft2 = 438.3151

fy2 = 365.2626

εsu2 = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798

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 = 365.2626

with Es2 = Es = 200000.00

εyv = 0.00152193

εshv = 0.00525983

ftv = 438.3151

fyv = 365.2626

εsuv = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00

lo/lou,min = lb/ld = 0.38146798

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 = 365.2626

with Esv = Es = 200000.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without

earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44

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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015

EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00

d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00

fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002

λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 8.2657E+006
Shear Force, V2 = -1.5070393E-013
Shear Force, V3 = -6384.747
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00710116
θu = θy + θp = 0.00825716

 - Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00325716 ((4.29),Biskinis Phd))
   My = 7.6151E+007
   Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1294.608
   From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.0089E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.5578607E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
      d = 357.00
      ξy = 0.2758284
      A = 0.01427707
      B = 0.00793591
       with pt = 0.00563199
            pc = 0.00574932
            pv = 0.00287466
            N = 766.5227
            b = 300.00
            δ'' = 0.11764706
Φy_comp = 1.7407225E-005
 with fc = 20.00
      Ec = 21019.039
      ξy = 0.27560804
      A = 0.01423507
      B = 0.00791481
       with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
   λ = 1
   db = 14.66667
   Mean strength value of all re-bars: fy = 444.44
   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 = 0.48563764
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 8.5758849E-005
- Stirrup Spacing <= d/2
  d = 357.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 148933.273,already given in calculation of shear control ratio
  design Shear = 6384.747
- (ρ-ρ')/ρbal = -0.160191
  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 = 0.01867766
  fc = 20.00
  fy = 444.44
  From 10.2.7.3, ACI 318-11: β1 = 0.85
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
  εy = 0.0022222
- V/(bw*d*fc^0.5) = 0.16053232, 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

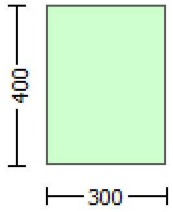
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

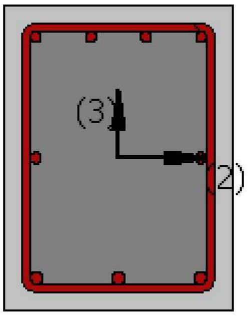
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





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

Constant Properties

Knowledge Factor, κ = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 8.2657E+006
Shear Force, Va = -6384.747
EDGE -B-
Bending Moment, Mb = 8.6155E+006
Shear Force, Vb = 11865.276
BOTH EDGES
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 170293.674
Vn ((22.5.1.1), ACI 318-14) = 198015.901

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 = 63974.614
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 0.24717913
Mu = 8.2657E+006
Vu = 6384.747
From (11.5.4.8), ACI 318-14: Vs = 134041.287
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

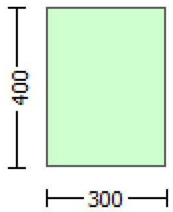
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

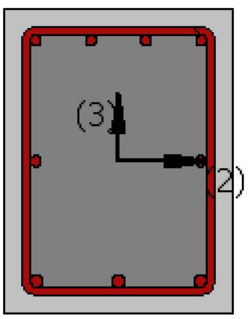
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





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

Section Type: rcars

Constant Properties

Knowledge Factor, κ = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626

εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:

Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005

Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00

Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.1950118E-010
Shear Force, V2 = -1.5070393E-013
Shear Force, V3 = -6384.747
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.0067475
θu = θy + θp = 0.00784593

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00284593 ((4.29),Biskinis Phd))
My = 5.2382E+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 = 5.6751E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 9.2287367E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 258.00
ξy = 0.28795092
A = 0.01481661
B = 0.00862348
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 766.5227
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.3070920E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.28774317
A = 0.01477303
B = 0.00860158

with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.46948745
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.4834348E-021
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 111699.955,already given in calculation of shear control ratio
design Shear = 1.5070393E-013
- (ρ-ρ')/ρbal = -0.16624473
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 = 0.01867766
fc = 20.00
fy = 444.44
From 10.2.7.3, ACI 318-11: β1 = 0.85
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
εy = 0.0022222
- V/(bw*d*fc^0.5) = 3.9323587E-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

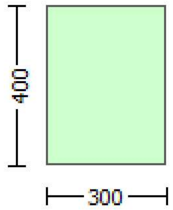
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

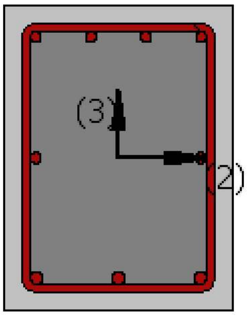
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





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

Constant Properties

Knowledge Factor, κ = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.1950118E-010

Shear Force, Va = -1.5070393E-013
EDGE -B-
Bending Moment, Mb = -1.5941812E-010
Shear Force, Vb = 1.5070393E-013
BOTH EDGES
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 117680.872
Vn ((22.5.1.1), ACI 318-14) = 136838.224

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 = 61440.00
λ = 1 (normal-weight concrete)
fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00641409
As (tension reinf.) = 615.7522
bw = 400.00
d = 240.00
Vu*d/Mu < 1 = 0.00
Mu = 1.5941812E-010
Vu = 1.5070393E-013
From (11.5.4.8), ACI 318-14: Vs = 75398.224
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

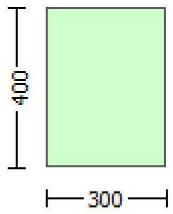
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

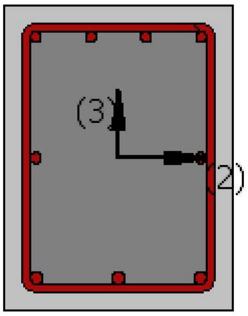
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





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

Constant Properties

Knowledge Factor, κ = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00

fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002

λc = confinement factor = 1.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55

fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00

From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012

Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 8.6155E+006
Shear Force, V2 = 1.5070393E-013
Shear Force, V3 = 11865.276
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00590221
θu = θy + θp = 0.00686303

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00186303 ((4.29),Biskinis Phd))
My = 7.7659E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 726.1115
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.0089E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.5624175E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 358.00
ξy = 0.27835267
A = 0.01423719
B = 0.00803436
with pt = 0.00573326
pc = 0.00561626
pv = 0.00286663
N = 766.5227
b = 300.00
δ'' = 0.12011173
Φy_comp = 1.7200799E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.2781365
A = 0.01419531
B = 0.00801331
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.48563764
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 5.0378505E-005
- Stirrup Spacing <= d/2

d = 358.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 148933.273,already given in calculation of shear control ratio
design Shear = 11865.276
- (ρ-ρ')/ρbal = -0.14721463
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 = 0.01867766
fc = 20.00
fy = 444.44
From 10.2.7.3, ACI 318-11: β1 = 0.85
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
εy = 0.0022222
- V/(bw*d*fc^0.5) = 0.29749645, 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

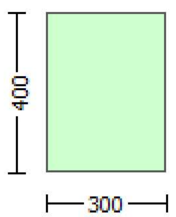
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

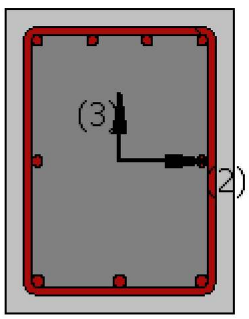
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





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

Section Type: rcars

Constant Properties

Knowledge Factor, κ = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 8.2657E+006
Shear Force, Va = -6384.747
EDGE -B-
Bending Moment, Mb = 8.6155E+006
Shear Force, Vb = 11865.276
BOTH EDGES
Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 172081.252
Vn ((22.5.1.1), ACI 318-14) = 200094.479

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 = 66053.192
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 0.44070366
Mu = 8.6155E+006
Vu = 11865.276
From (11.5.4.8), ACI 318-14: Vs = 134041.287
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

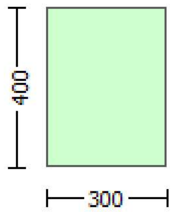
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

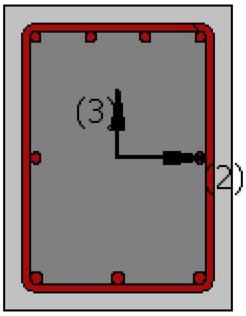
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





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

Constant Properties

Knowledge Factor, κ = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00

Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403

fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798

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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981

Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608

bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00

ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00

Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00

psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626

with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.5941812E-010
Shear Force, V2 = 1.5070393E-013
Shear Force, V3 = 11865.276

Axial Force, F = -766.5227
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.0067475
θu = θy + θp = 0.00784593

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00284593 ((4.29),Biskinis Phd))
My = 5.2382E+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 = 5.6751E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 9.2287367E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 258.00
ξy = 0.28795092
A = 0.01481661
B = 0.00862348
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 766.5227
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.3070920E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.28774317
A = 0.01477303
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.46948745
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
    θ = -1.6837755E-022
- Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 111699.955,already given in calculation of shear control ratio
  design Shear = 1.5070393E-013
- (ρ-ρ')/ρbal = -0.15320593
  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 = 0.01867766
   fc = 20.00
   fy = 444.44
   From 10.2.7.3, ACI 318-11: β1 = 0.85
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
     εy = 0.0022222
- V/(bw*d*fc^0.5) = 3.9323587E-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

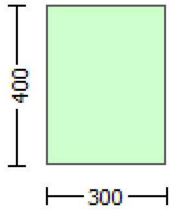
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

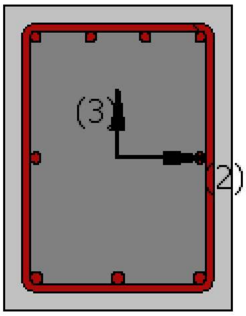
Analysis: Uniform +X

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 = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -9.9059446E-011
Shear Force, Va = -1.2476340E-013
EDGE -B-
Bending Moment, Mb = -1.3184949E-010
Shear Force, Vb = 1.2476340E-013
BOTH EDGES
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 117680.872
Vn ((22.5.1.1), ACI 318-14) = 136838.224

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 = 61440.00
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 9.9059446E-011
Vu = 1.2476340E-013
From (11.5.4.8), ACI 318-14: Vs = 75398.224
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

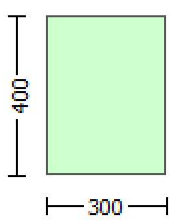
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

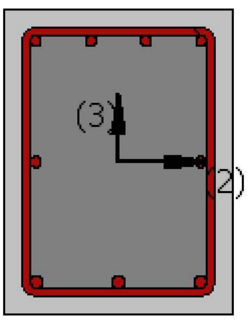
Analysis: Uniform +X

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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151

fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626

εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.

Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 6.8277E+006
Shear Force, V2 = -1.2476340E-013
Shear Force, V3 = -4795.926
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02887979
θu = θy + θp = 0.03358115

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00358115 ((4.29),Biskinis Phd))
My = 7.6137E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1423.647
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.0089E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.5574664E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 357.00
ξy = 0.27578486
A = 0.01427447
B = 0.00793331
with pt = 0.00563199
pc = 0.00574932
pv = 0.00287466
N = 672.0671
b = 300.00
δ" = 0.11764706
Φy_comp = 1.7408263E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.27559161
A = 0.01423765

B = 0.00791481
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.48563764
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 7.4740824E-005
- Stirrup Spacing <= d/2
d = 357.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 148933.273,already given in calculation of shear control ratio
design Shear = 4795.926
- (ρ-ρ')/ρbal = -0.160191
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 = 0.01867766
fc = 20.00
fy = 444.44
From 10.2.7.3, ACI 318-11: β1 = 0.85
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
εy = 0.0022222
- V/(bw*d*fc^0.5) = 0.12058442, 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

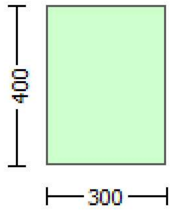
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

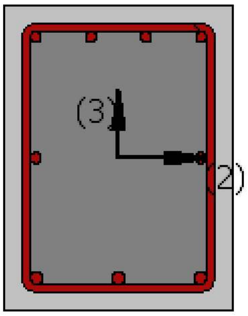
Analysis: Uniform +X

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 = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.8277E+006

Shear Force, Va = -4795.926
EDGE -B-
Bending Moment, Mb = 7.1142E+006
Shear Force, Vb = 10276.454
BOTH EDGES
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 170096.101
Vn ((22.5.1.1), ACI 318-14) = 197786.164

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 = 63744.877
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 0.22477489
Mu = 6.8277E+006
Vu = 4795.926
From (11.5.4.8), ACI 318-14: Vs = 134041.287
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

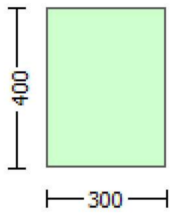
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

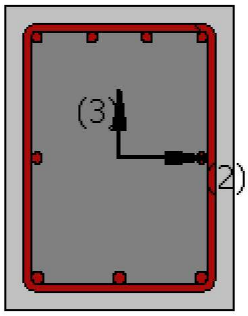
Analysis: Uniform +X

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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00

fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002

λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007

----

with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----

psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00

ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55

fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00

From ((5.A5), TBDY), TBDY: $\varepsilon cc = 0.002$
λc = confinement factor = 1.00
$\varepsilon y1 = 0.00152193$
$\varepsilon sh1 = 0.00525983$
ft1 = 438.3151
fy1 = 365.2626
$\varepsilon su1 = 0.00824837$
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
$\varepsilon su1$ = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and $\varepsilon y1$,$\varepsilon sh1$,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, 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 fs1 = fs = 365.2626
with Es1 = Es = 200000.00
$\varepsilon y2 = 0.00152193$
$\varepsilon sh2 = 0.00525983$
ft2 = 438.3151
fy2 = 365.2626
$\varepsilon su2 = 0.00824837$
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
$\varepsilon su2$ = 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 = 365.2626
with Es2 = Es = 200000.00
$\varepsilon yv = 0.00152193$
$\varepsilon shv = 0.00525983$
ftv = 438.3151
fyv = 365.2626
$\varepsilon suv = 0.00824837$
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002

λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012

Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -9.9059446E-011
Shear Force, V2 = -1.2476340E-013
Shear Force, V3 = -4795.926
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02824702
θu = θy + θp = 0.03284537

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00284537 ((4.29),Biskinis Phd))
My = 5.2371E+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 = 5.6751E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 9.2281840E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 258.00
ξy = 0.28790828
A = 0.01481392
B = 0.00862078
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 672.0671
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.3072289E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.28772609
A = 0.0147757
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.46948745
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.2209201E-021
- Stirrup Spacing > d/2

d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 111699.955,already given in calculation of shear control ratio
design Shear = 1.2476340E-013
- (ρ-ρ')/ρbal = -0.16624473
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 = 0.01867766
fc = 20.00
fy = 444.44
From 10.2.7.3, ACI 318-11: β1 = 0.85
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
εy = 0.0022222
- V/(bw*d*fc^0.5) = 3.2554852E-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

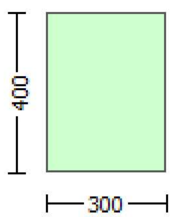
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

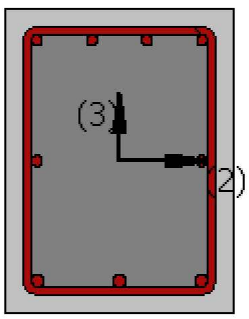
Analysis: Uniform +X

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 = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -9.9059446E-011
Shear Force, Va = -1.2476340E-013
EDGE -B-
Bending Moment, Mb = -1.3184949E-010
Shear Force, Vb = 1.2476340E-013
BOTH EDGES
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 117680.872
Vn ((22.5.1.1), ACI 318-14) = 136838.224

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 = 61440.00
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 1.3184949E-010
Vu = 1.2476340E-013
From (11.5.4.8), ACI 318-14: Vs = 75398.224
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

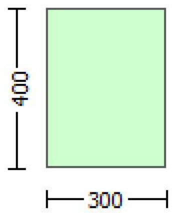
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

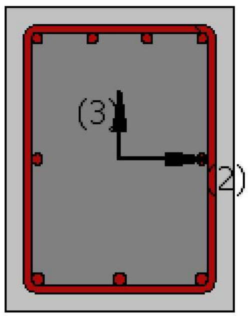
Analysis: Uniform +X

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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00

Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459

N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007
φu = φsu (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403

fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00

Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
λ = 1 (normal-weight concrete)
fc' = 20.00, 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 = 300.00
d = 320.00
Vu*d/Mu < 1 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel

Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192

ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608

bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00

ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----

psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00

Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 7.1142E+006
Shear Force, V2 = 1.2476340E-013

Shear Force, V3 = 10276.454
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02732729
θu = θy + θp = 0.03177591

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00177591 ((4.29),Biskinis Phd))
My = 7.7645E+007
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 692.2851
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.0089E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.5620261E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 358.00
ξy = 0.27830963
A = 0.0142346
B = 0.00803177
with pt = 0.00573326
pc = 0.00561626
pv = 0.00286663
N = 672.0671
b = 300.00
δ'' = 0.12011173
Φy_comp = 1.7201816E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.27812006
A = 0.01419788
B = 0.00801331
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.48563764
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 3.7692674E-005
- Stirrup Spacing <= d/2
  d = 358.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 148933.273,already given in calculation of shear control ratio
  design Shear = 10276.454
- (ρ-ρ')/ρbal = -0.14721463
  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 = 0.01867766
  fc = 20.00
  fy = 444.44
  From 10.2.7.3, ACI 318-11: β1 = 0.85
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
  εy = 0.0022222
- V/(bw*d*fc^0.5) = 0.25766015, 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

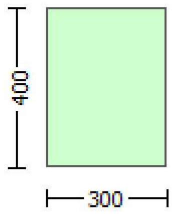
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

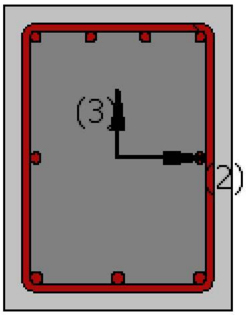
Analysis: Uniform +X

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 = 0.86
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 6.8277E+006
Shear Force, Va = -4795.926
EDGE -B-
Bending Moment, Mb = 7.1142E+006
Shear Force, Vb = 10276.454
BOTH EDGES
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 172275.104
Vn ((22.5.1.1), ACI 318-14) = 200319.888

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 = 66278.602
λ = 1 (normal-weight concrete)
fc' = 16.00, 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 = 0.46223734
Mu = 7.1142E+006
Vu = 10276.454
From (11.5.4.8), ACI 318-14: Vs = 134041.287
Av = 157079.633
fy = 400.00
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 <= 255092.67

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

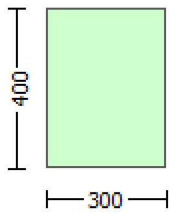
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

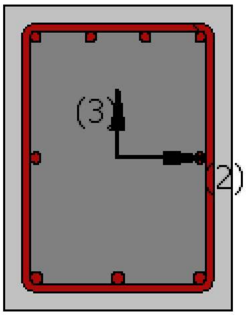
Analysis: Uniform +X

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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
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 = -224.0403
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 = 0.48563764
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 = 110666.834
with
Mpr1 = Max(Mu1+ , Mu1-) = 9.9873E+007
Mu1+ = 9.8146E+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- = 9.9873E+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-) = 9.9791E+007
Mu2+ = 9.8227E+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- = 9.9791E+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 = 2.8227664E-005
Mu = 9.8146E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983

ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10285771
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10500058
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14036775
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14329208
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18148811
Mu = MRc (4.14) = 9.8146E+007

$\varphi u = \varphi su$ (4.1) = 2.8227664E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8240029E-005
Mu = 9.9873E+007
----
with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151

fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10470728
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1025704
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14285521
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.1399398
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18413183
Mu = MRc (4.14) = 9.9873E+007
φu = φsu (4.1) = 2.8240029E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8176912E-005
Mu = 9.8227E+007

----

with full section properties:
b = 300.00
d = 358.00
d' = 43.00
v = 0.0001043
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----

psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626

εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1025704
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10470728
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05235364
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.1399398
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14285521
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07142761
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18230426
Mu = MRc (4.14) = 9.8227E+007
φu = φsu (4.1) = 2.8176912E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 2.8291311E-005
Mu = 9.9791E+007
----
with full section properties:
b = 300.00
d = 357.00
d' = 42.00
v = 0.00010459
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10500058
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10285771
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05250029
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.14329208
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.14036775
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07164604
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.18332949
Mu = MRc (4.14) = 9.9791E+007
φu = φsu (4.1) = 2.8291311E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 227879.44

Calculation of Shear Strength at edge 1, Vr1 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 227879.44
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 = 78946.167
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 = 1.00
Mu = 6710.981
Vu = 2740.264
From (11.5.4.8), ACI 318-14: Vs = 148933.273
Av = 157079.633
fy = 444.44
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 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 = 0.86
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -1.7207416E-015
EDGE -B-
Shear Force, Vb = 1.7207416E-015
BOTH EDGES
Axial Force, F = -224.0403
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 = 0.46948745
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 = 71581.331
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.6213E+007
Mu1+ = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the actual moment direction

which is defined for the static loading combination
Mu1- = 6.6213E+007, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 6.6213E+007
Mu2+ = 6.6213E+007, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 6.6213E+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 = -1.7207416E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 1.7207416E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798

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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00

ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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 = 4.0374766E-005
Mu = 6.6213E+007
----
with full section properties:
b = 400.00
d = 258.00
d' = 42.00
v = 0.00010855
N = 224.0403
fc = 20.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00583896
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00583896
ωwe (5.4c) = 0.0034192
ase ((5.4d), TBDY) = 0.15672608
bo = 240.00
ho = 340.00
Σbi2 = 346400.00
psh,min = Min(psh,x , psh,y) = 0.00261799
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh,x (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 = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00152193
εsh1 = 0.00525983
ft1 = 438.3151
fy1 = 365.2626
εsu1 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Es1 = Es = 200000.00
εy2 = 0.00152193
εsh2 = 0.00525983
ft2 = 438.3151
fy2 = 365.2626
εsu2 = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with 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 = 0.38146798
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 = 365.2626
with Es2 = Es = 200000.00
εyv = 0.00152193
εshv = 0.00525983
ftv = 438.3151
fyv = 365.2626
εsuv = 0.00824837
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.38146798
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 = 365.2626
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09006591
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09006591
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.09006591
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 20.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11990198
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11990198
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.11990198
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.20815818
Mu = MRc (4.14) = 6.6213E+007
φu = φsu (4.1) = 4.0374766E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.38146798
lb = 300.00
ld = 786.4356
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1

db = 14.66667
Mean strength value of all re-bars: fy = 555.55
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) = 152466.975

Calculation of Shear Strength at edge 1, Vr1 = 152466.975
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 = 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 = 2.0990525E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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

Calculation of Shear Strength at edge 2, Vr2 = 152466.975
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 = 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 = 1.0843269E-012
Vu = 1.7207416E-015
From (11.5.4.8), ACI 318-14: Vs = 83774.966
Av = 157079.633
fy = 444.44
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 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 = 0.86
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.3184949E-010
Shear Force, V2 = 1.2476340E-013
Shear Force, V3 = 10276.454
Axial Force, F = -672.0671
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

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02824702
θu = θy + θp = 0.03284537

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00284537 ((4.29),Biskinis Phd))
My = 5.2371E+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 = 5.6751E+012

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)

Φy_ten = 9.2281840E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 339.0798
d = 258.00
ξy = 0.28790828
A = 0.01481392
B = 0.00862078
with pt = 0.00493157
pc = 0.00493157
pv = 0.00493157
N = 672.0671
b = 400.00
δ'' = 0.1627907
Φy_comp = 2.3072289E-005
with fc = 20.00
Ec = 21019.039
ξy = 0.28772609
A = 0.0147757
B = 0.00860158
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.47683497
lb = 300.00
ld = 629.1485
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 14.66667
Mean strength value of all re-bars: fy = 444.44
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 = 0.46948745
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = -1.3143273E-022
- Stirrup Spacing > d/2
d = 258.00
s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 111699.955,already given in calculation of shear control ratio
design Shear = 1.2476340E-013
- (ρ-ρ')/ρbal = -0.15320593
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 = 0.01867766
fc = 20.00
fy = 444.44

From 10.2.7.3, ACI 318-11: β1 = 0.85
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.57447053
εy = 0.0022222
- V/(bw*d*fc^0.5) = 3.2554852E-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)
