Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

beam B1, Floor 1

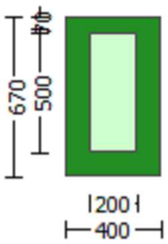
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

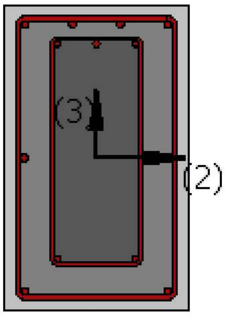
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00

Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.8888022E-011
Shear Force, Va = 8.5432615E-015
EDGE -B-
Bending Moment, Mb = 5.4215417E-011
Shear Force, Vb = -8.5432615E-015
BOTH EDGES
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 294422.714
Vn ((22.5.1.1), ACI 318-14) = 327136.349

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 = 159584.741
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 2.8888022E-011
Vu = 8.5432615E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
Vs1 = 167551.608 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 500.00
s = 150.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for core, with:
d = 160.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 2

beam B1, Floor 1

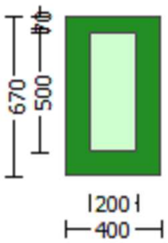
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

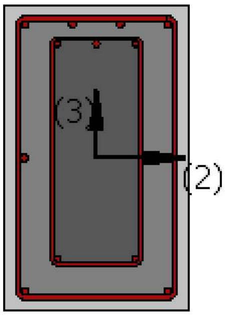
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661

ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008

φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796

No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299

and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00

psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434

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

----

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00

----

psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755

fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00

v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661

ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00

Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:

d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES

Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539

ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531

No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00

fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)

Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00

Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 8.9415E+006
Shear Force, V2 = 8.5432615E-015
Shear Force, V3 = 1226.091
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 402.1239
-Compression: Asl,com,jacket = 804.2477
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 461.8141
-Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.01331369
θu = θy + θp = 0.01479299

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00479299 ((4.29),Biskinis Phd))
My = 1.8555E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 6000.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.7426E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 3.6547586E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 627.00
ξy = 0.18654435
A = 0.00958561
B = 0.00413701
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 9649.98
b = 400.00
δ'' = 0.06858054

Φy_comp = 1.9009820E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.18458061
A = 0.00939495
B = 0.0040338
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.01
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 = 0.49656722
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 7.8778516E-005
- Stirrup Spacing <= d/2
d = d_external = 627.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 371407.964,already given in calculation of shear control ratio
design Shear = 1226.091
- (ρ-ρ')/ρbal = -0.26284228
ρ = Aslt/(bw*d) = 0.00283094
Tension Reinf Area: Aslt = 709.9999
ρ' = Aslc/(bw*d) = 0.00665146
Compression Reinf Area: Aslc = 1668.186
From (B-1), ACI 318-11: ρbal = 0.0145354
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
fy = fy_jacket_bars = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.01109647, NOTE: units in lb & in
bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 3

beam B1, Floor 1

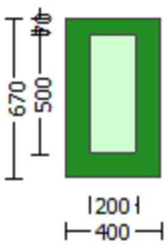
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

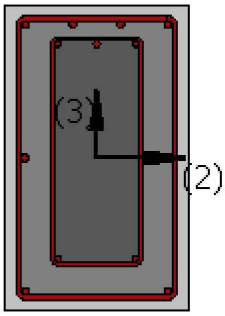
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 8.9415E+006
Shear Force, Va = 1226.091
EDGE -B-
Bending Moment, Mb = 1.6903E+007
Shear Force, Vb = 18455.175
BOTH EDGES
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 421136.164
Vn ((22.5.1.1), ACI 318-14) = 467929.071

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 = 160471.87
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 0.07349869
Mu = 8.9415E+006
Vu = 1226.091
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 307457.201
Vs1 = 280648.944 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 26808.257 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 4

beam B1, Floor 1

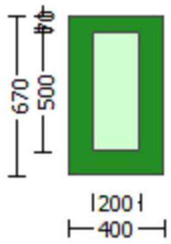
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

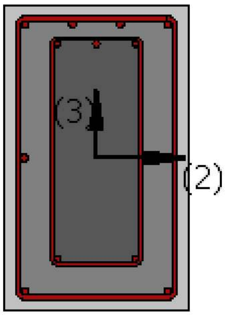
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55

###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:

b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539

with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154

ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00

From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00

----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962

with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00

ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355

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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00

h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:

b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434

Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62

εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896

N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475

fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216

n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661

ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008

φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.8888022E-011
Shear Force, V2 = 8.5432615E-015
Shear Force, V3 = 1226.091
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 603.1858
-Compression: Asl,com,jacket = 603.1858
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 307.8761
-Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00690626
θu = θy + θp = 0.00767362

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00267362 ((4.29),Biskinis Phd))
My = 1.3478E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 2.5206E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.7373176E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 357.00
ξy = 0.22499433
A = 0.01005088
B = 0.00567834
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 9649.98
b = 670.00
δ'' = 0.12044818
Φy_comp = 2.7583235E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.22341802
A = 0.00985097
B = 0.00557012
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144

lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005
with:
- Condition iv occured
Beam controlled by inadequate embedment into beam-column joint:
(lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.30156355
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 4.2781173E-023
- Stirrup Spacing <= d/2
d = d_external = 357.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 209999.267,already given in calculation of shear control ratio
design Shear = 8.5432615E-015
- (ρ-ρ')/ρbal = -0.27560034
ρ = Aslt/(bw*d) = 0.00296835
Tension Reinf Area: Aslt = 709.9999
ρ' = Aslc/(bw*d) = 0.00697431
Compression Reinf Area: Aslc = 1668.186
From (B-1), ACI 318-11: ρbal = 0.0145354
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
fy = fy_jacket_bars = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 8.1071922E-020, NOTE: units in lb & in
bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 5

beam B1, Floor 1

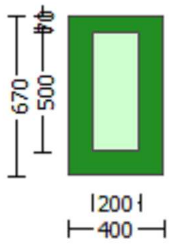
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

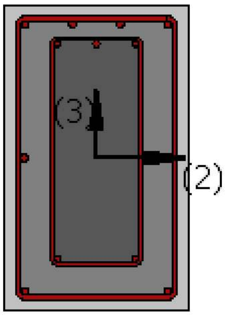
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.8888022E-011
Shear Force, Va = 8.5432615E-015
EDGE -B-
Bending Moment, Mb = 5.4215417E-011
Shear Force, Vb = -8.5432615E-015
BOTH EDGES
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 294422.714
Vn ((22.5.1.1), ACI 318-14) = 327136.349

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 = 159584.741
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 5.4215417E-011
Vu = 8.5432615E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
Vs1 = 167551.608 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for core, with:
d = 160.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 6

beam B1, Floor 1

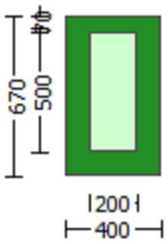
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

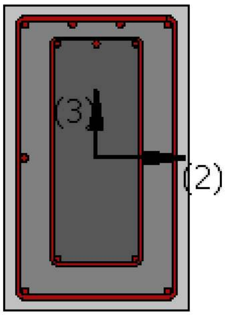
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895

ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304

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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00

s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00

h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632

From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:

Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00

From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00

----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62

with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00

ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----

with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439

ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56

s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 1.6903E+007
Shear Force, V2 = -8.5432615E-015
Shear Force, V3 = 18455.175
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)

-Tension: Asl,ten,jacket = 402.1239
-Compression: Asl,com,jacket = 804.2477
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 461.8141
-Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00965848
θu = θy + θp = 0.01073164

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00073164 ((4.29),Biskinis Phd))
My = 1.8555E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 915.8861
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.7426E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 3.6547586E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 627.00
ξy = 0.18654435
A = 0.00958561
B = 0.00413701
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 9649.98
b = 400.00
δ'' = 0.06858054
Φy_comp = 1.9009820E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.18458061
A = 0.00939495
B = 0.0040338
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.01
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 = 0.49656722
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 1.7836020E-005
- Stirrup Spacing <= d/2
  d = d_external = 627.00
  s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 371407.964,already given in calculation of shear control ratio
  design Shear = 18455.175
- (ρ-ρ')/ρbal = -0.26284228
  ρ = Aslt/(bw*d) = 0.00283094
  Tension Reinf Area: Aslt = 709.9999
  ρ' = Aslc/(bw*d) = 0.00665146
  Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: ρbal = 0.0145354
  fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
  fy = fy_jacket_bars = 555.56
  From 10.2.7.3, ACI 318-11: β1 = 0.65
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
  εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.16702459, NOTE: units in lb & in
  bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 7

beam B1, Floor 1

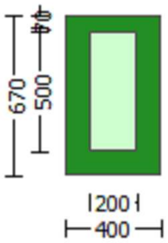
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

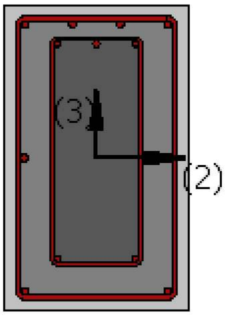
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 8.9415E+006
Shear Force, Va = 1226.091
EDGE -B-
Bending Moment, Mb = 1.6903E+007
Shear Force, Vb = 18455.175
BOTH EDGES
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062

-Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 426695.053
Vn ((22.5.1.1), ACI 318-14) = 474105.614

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 = 166648.413
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 0.58522559
Mu = 1.6903E+007
Vu = 18455.175
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 307457.201
Vs1 = 280648.944 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 26808.257 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 8

beam B1, Floor 1

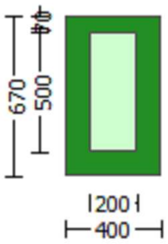
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

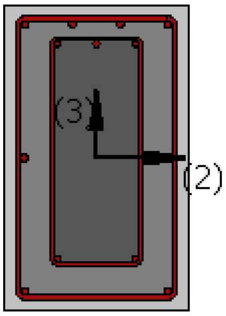
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895

ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304

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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00

s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00

h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632

From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:

Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00

From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00

----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62

with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00

ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----

with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439

ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56

s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 5.4215417E-011
Shear Force, V2 = -8.5432615E-015
Shear Force, V3 = 18455.175
Axial Force, F = -9649.98
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)

-Tension: Asl,ten,jacket = 603.1858
-Compression: Asl,com,jacket = 603.1858
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 307.8761
-Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.00690626
θu = θy + θp = 0.00767362

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00267362 ((4.29),Biskinis Phd))
My = 1.3478E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 2.5206E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.7373176E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 357.00
ξy = 0.22499433
A = 0.01005088
B = 0.00567834
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 9649.98
b = 670.00
δ" = 0.12044818
Φy_comp = 2.7583235E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.22341802
A = 0.00985097
B = 0.00557012
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- Calculation of θp -

From table 10-7: θp = 0.005
with:
- Condition iv occured
  Beam controlled by inadequate embedment into beam-column joint:
  (lb/ld < 1 and With Lapping in the Vicinity of the End Regions
- Condition i occured
  Beam controlled by flexure: Vp/Vo <= 1
  shear control ratio Vp/Vo = 0.30156355
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
    θ = 3.5037908E-022
- Stirrup Spacing <= d/2
  d = d_external = 357.00
  s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 209999.267,already given in calculation of shear control ratio
  design Shear = 8.5432615E-015
- (ρ-ρ')/ρbal = -0.27560034
  ρ = Aslt/(bw*d) = 0.00296835
   Tension Reinf Area: Aslt = 709.9999
  ρ' = Aslc/(bw*d) = 0.00697431
   Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: ρbal = 0.0145354
   fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
   fy = fy_jacket_bars = 555.56
   From 10.2.7.3, ACI 318-11: β1 = 0.65
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
     εy = 0.0027778
- V/(bw*d*fc^0.5) = 8.1071922E-020, NOTE: units in lb & in
   bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

beam B1, Floor 1

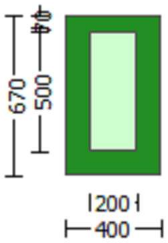
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

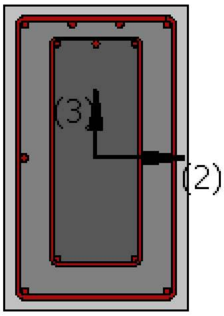
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.3053354E-011
Shear Force, Va = 7.9342457E-015
EDGE -B-
Bending Moment, Mb = 4.6602998E-011
Shear Force, Vb = -7.9342457E-015
BOTH EDGES
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619

-Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 294422.714
Vn ((22.5.1.1), ACI 318-14) = 327136.349

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 = 159584.741
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 2.3053354E-011
Vu = 7.9342457E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
Vs1 = 167551.608 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for core, with:
d = 160.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 10

beam B1, Floor 1

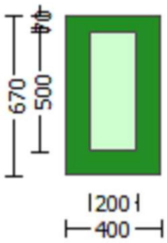
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

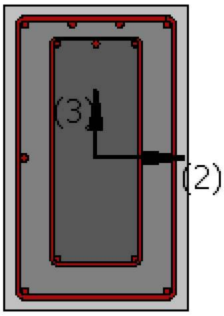
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES

Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539

ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531

No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00

fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)

2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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

Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00

s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00

ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895

ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80

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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 7.2837E+006
Shear Force, V2 = 7.9342457E-015
Shear Force, V3 = 2647.068
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 402.1239
-Compression: Asl,com,jacket = 804.2477
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 461.8141
-Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02897469 θu = θy + θp = 0.0321941

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.0021941 ((4.29),Biskinis Phd))
My = 1.8522E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 2751.604
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.7426E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 3.6533922E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 627.00
ξy = 0.1862401
A = 0.00957261
B = 0.00412402
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 8435.262
b = 400.00
δ" = 0.06858054
Φy_comp = 1.9015919E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.18452141
A = 0.00940596
B = 0.0040338
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- 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 = 0.49656722
- Transverse Reinforcement: C

- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
    θ = 6.9341116E-005
- Stirrup Spacing <= d/2
  d = d_external = 627.00
  s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 371407.964,already given in calculation of shear control ratio
  design Shear = 2647.068
- (ρ-ρ')/ρbal = -0.26284228
  ρ = Aslt/(bw*d) = 0.00283094
    Tension Reinf Area: Aslt = 709.9999
  ρ' = Aslc/(bw*d) = 0.00665146
    Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: ρbal = 0.0145354
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
    fy = fy_jacket_bars = 555.56
    From 10.2.7.3, ACI 318-11: β1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
      εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.02395672, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 11

beam B1, Floor 1

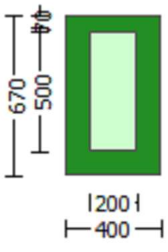
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

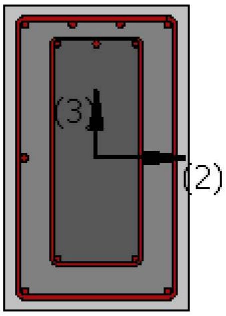
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 7.2837E+006
Shear Force, Va = 2647.068
EDGE -B-
Bending Moment, Mb = 1.4298E+007
Shear Force, Vb = 17034.198
BOTH EDGES
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 422453.811
Vn ((22.5.1.1), ACI 318-14) = 469393.123

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 = 161935.922

λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 0.19479549
Mu = 7.2837E+006
Vu = 2647.068
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 307457.201
Vs1 = 280648.944 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 26808.257 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 12

beam B1, Floor 1

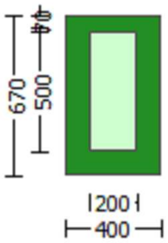
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

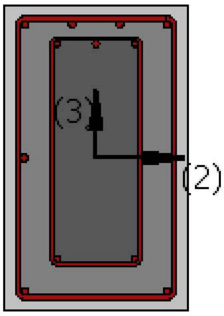
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES

Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539

ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531

No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00

fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)

2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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

Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00

s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419

ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00

ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895

ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80

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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.3053354E-011
Shear Force, V2 = 7.9342457E-015
Shear Force, V3 = 2647.068
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 603.1858
-Compression: Asl,com,jacket = 603.1858
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 307.8761
-Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02940284 θu = θy + θp = 0.03266982

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00266982 ((4.29),Biskinis Phd))
My = 1.3459E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 2.5206E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.7350463E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 357.00
ξy = 0.22473297
A = 0.01003726
B = 0.00566471
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 8435.262
b = 670.00
δ'' = 0.12044818
Φy_comp = 2.7591192E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.22335359
A = 0.00986252
B = 0.00557012
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- 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 = 0.30156355
- Transverse Reinforcement: NC

- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
  θ = 3.7007407E-023
- Stirrup Spacing <= d/2
  d = d_external = 357.00
  s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 209999.267,already given in calculation of shear control ratio
  design Shear = 7.9342457E-015
- (ρ-ρ')/ρbal = -0.27560034
  ρ = Aslt/(bw*d) = 0.00296835
  Tension Reinf Area: Aslt = 709.9999
  ρ' = Aslc/(bw*d) = 0.00697431
  Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: ρbal = 0.0145354
  fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
  fy = fy_jacket_bars = 555.56
  From 10.2.7.3, ACI 318-11: β1 = 0.65
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
  εy = 0.0027778
- V/(bw*d*fc^0.5) = 7.5292621E-020, NOTE: units in lb & in
  bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 13

beam B1, Floor 1

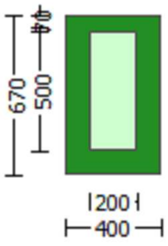
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

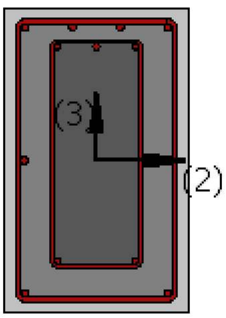
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -2.3053354E-011
Shear Force, Va = 7.9342457E-015
EDGE -B-
Bending Moment, Mb = 4.6602998E-011
Shear Force, Vb = -7.9342457E-015
BOTH EDGES
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 294422.714
Vn ((22.5.1.1), ACI 318-14) = 327136.349

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 = 159584.741

λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 4.6602998E-011
Vu = 7.9342457E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
Vs1 = 167551.608 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for core, with:
d = 160.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 14

beam B1, Floor 1

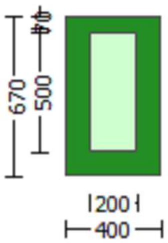
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

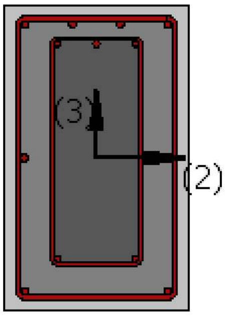
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (2)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722

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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00

h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:

b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434

Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962

εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619

N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682

fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216

n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661

ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008

φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
ρw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <=

8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-
Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00

h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00

εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539

ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00

Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 1.4298E+007
Shear Force, V2 = -7.9342457E-015
Shear Force, V3 = 17034.198
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 402.1239
-Compression: Asl,com,jacket = 804.2477
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 461.8141
-Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02760236
θu = θy + θp = 0.03066928

- Calculation of θy -

θy = (My*Ls/3)/EIeff = 0.00066928 ((4.29),Biskinis Phd))
My = 1.8522E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 839.3447
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.7426E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 3.6533922E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 627.00
ξy = 0.1862401
A = 0.00957261
B = 0.00412402
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 8435.262
b = 400.00
δ'' = 0.06858054
Φy_comp = 1.9015919E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.18452141
A = 0.00940596
B = 0.0040338
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- 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 = 0.49656722
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.1336755E-005
- Stirrup Spacing <= d/2
d = d_external = 627.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 371407.964,already given in calculation of shear control ratio
design Shear = 17034.198
- (ρ-ρ')/ρbal = -0.26284228
ρ = Aslt/(bw*d) = 0.00283094
Tension Reinf Area: Aslt = 709.9999
ρ' = Aslc/(bw*d) = 0.00665146

Compression Reinf Area: Aslc = 1668.186
From (B-1), ACI 318-11: ρbal = 0.0145354
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
fy = fy_jacket_bars = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 0.15416434, NOTE: units in lb & in
bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 15

beam B1, Floor 1

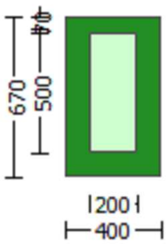
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

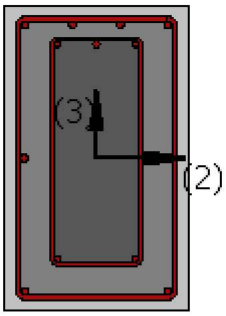
Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket

New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 7.2837E+006
Shear Force, Va = 2647.068
EDGE -B-
Bending Moment, Mb = 1.4298E+007
Shear Force, Vb = 17034.198
BOTH EDGES
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = κ*Vn = 427274.788
Vn ((22.5.1.1), ACI 318-14) = 474749.764

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 = 167292.563
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 21.64179, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 0.63859341
Mu = 1.4298E+007
Vu = 17034.198
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 307457.201
Vs1 = 280648.944 is calculated for jacket, with:
d = 536.00
Av = 157079.633

fy = 500.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 26808.257 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 400.00
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 662579.716

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 16

beam B1, Floor 1

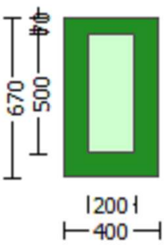
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

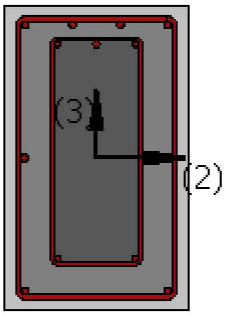
Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)





Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00

New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 709.9999
-Compression: Asl,com = 1266.062
-Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.49656722
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 = 266008.163
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.8425E+008
Mu1+ = 2.2952E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 3.8425E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.8425E+008
Mu2+ = 2.2952E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.8425E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and

± wu*ln = (|V1| + |V2|)/2
with
V1 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00

εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
$\varphi u = \varphi su$ (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434

ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.06089352

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.2638035E-005
Mu = 2.2952E+008
----
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00

ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 470.5847
fy1 = 392.1539
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 392.1539
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 477.682
fy2 = 398.0683
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 398.0683
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581

εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.03364135
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.06089352
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0415669
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0752394
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1217168
Mu = MRc (4.14) = 2.2952E+008
φu = φsu (4.1) = 1.2638035E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 1.3095001E-005
Mu = 3.8425E+008
----
with full section properties:
b = 400.00

d = 627.00
d' = 43.00
v = 0.00027619
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 477.682
fy1 = 398.0683
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 398.0683
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00

$\varepsilon y2$ = 0.00154581
$\varepsilon sh2$ = 0.00494661
ft2 = 470.5847
fy2 = 392.1539
$\varepsilon su2$ = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
$\varepsilon su2$ = 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 392.1539
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 515.2755
fyv = 429.3962
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 429.3962
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.06089352
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.03364135
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02086299
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
$\omega 1$ = Asl,ten/(b*d)*(fs1/fc) = 0.0752394
$\omega 2$ = Asl,com/(b*d)*(fs2/fc) = 0.0415669
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.0257781
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.1523656
Mu = MRc (4.14) = 3.8425E+008
φu = φsu (4.1) = 1.3095001E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80

ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 535694.165

Calculation of Shear Strength at edge 1, Vr1 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.632
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 535694.165
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 = 194072.856
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 400.00
d = 536.00
Vu*d/Mu < 1 = 1.00
Mu = 1.1086E+006
Vu = 9840.634
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 341621.309
Vs1 = 311834.654 is calculated for jacket, with:
d = 536.00
Av = 157079.633
fy = 555.56
s = 150.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 29786.655 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
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 = 4.8511603E-015
EDGE -B-

Shear Force, Vb = -4.8511603E-015
BOTH EDGES
Axial Force, F = -2285.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.30156355
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 = 111027.496
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.6654E+008
Mu1+ = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
Mu1- = 1.6654E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.6654E+008
Mu2+ = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 1.6654E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
V1 = 4.8511603E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = -4.8511603E-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 = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)

----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00

εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729

εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 2.2916591E-005
Mu = 1.6654E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.0002896
N = 2285.866
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00512221
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00512221
ωwe (5.4c) = 0.00164473
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
ase1 = 0.14776895
bo_1 = 340.00
ho_1 = 610.00
Σbi2_1 = 975400.00
ase2 = Max(ase1,ase2) = 0.14776895
bo_2 = 192.00
ho_2 = 492.00
Σbi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.22434
Expression ((5.4d), TBDY) for psh,min*Fywe has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.16539
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 670.00
ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 500.00
----
psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.22434
ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
Ash1 = Astir_1*ns_1 = 157.0796
No stirups, ns_1 = 2.00
h1 = 400.00

ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
Ash2 = Astir_2*ns_2 = 100.531
No stirups, ns_2 = 2.00
h2 = 200.00

Asec = 268000.00
s1 = 150.00
s2 = 300.00
fywe1 = 694.45
fywe2 = 555.55
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.002
λc = confinement factor = 1.00
εy1 = 0.00154581
εsh1 = 0.00494661
ft1 = 480.4475
fy1 = 400.3729
εsu1 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 400.3729
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.00154581
εsh2 = 0.00494661
ft2 = 480.4475
fy2 = 400.3729
εsu2 = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.34790516
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 400.3729
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.00154581
εshv = 0.00494661
ftv = 486.7441
fyv = 405.62
εsuv = 0.00695956
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.34790516
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 405.62
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04621209
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.04621209
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02857496
and confined core properties:
b = 610.00

d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
εcc (5A.5, TBDY) = 0.002
λc = confinement factor = 1.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05541419
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05541419
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03426502
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.14932546
Mu = MRc (4.14) = 1.6654E+008
φu = φsu (4.1) = 2.2916591E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.34790516
lb = 300.00
ld = 862.304
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 = 15.23077
Mean strength value of all re-bars: fy = 645.3439
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 368172.80

Calculation of Shear Strength at edge 1, Vr1 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 6.4841010E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d2 = 160.00
Av = 100530.965
fy = 444.44

s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

Calculation of Shear Strength at edge 2, Vr2 = 368172.80
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 = 182002.857
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 28.14925, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
pw = As/(bw*d) = 0.00331157
As (tension reinf.) = 709.9999
bw = 670.00
d = 320.00
Vu*d/Mu < 1 = 0.00
Mu = 8.0658469E-012
Vu = 4.8511603E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 186169.943
Vs1 = 186169.943 is calculated for jacket, with:
d = 320.00
Av = 157079.633
fy = 555.56
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
d = 160.00
Av = 100530.965
fy = 444.44
s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 755657.47

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

Constant Properties

Knowledge Factor, κ = 0.90
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:
Jacket
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00

Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 4.6602998E-011
Shear Force, V2 = -7.9342457E-015
Shear Force, V3 = 17034.198
Axial Force, F = -8435.262
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: Aslt = 709.9999
-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten = 911.0619
-Compression: Asl,com = 911.0619
-Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,jacket = 603.1858
-Compression: Asl,com,jacket = 603.1858
-Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
-Tension: Asl,ten,core = 307.8761
-Compression: Asl,com,core = 307.8761
-Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = κ*θu = 0.02940284
θu = θy + θp = 0.03266982

- Calculation of θy -

θy = (My*Ls/3)/Eleff = 0.00266982 ((4.29),Biskinis Phd))
My = 1.3459E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 2.5206E+013

Calculation of Yielding Moment My

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

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 6.7350463E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 372.8122
d = 357.00
ξy = 0.22473297
A = 0.01003726
B = 0.00566471
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 8435.262

b = 670.00
δ" = 0.12044818
Φy_comp = 2.7591192E-005
with fc = 28.14925
Ec = 26999.444
ξy = 0.22335359
A = 0.00986252
B = 0.00557012
with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.43488144
lb = 300.00
ld = 689.8432
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
λ = 1
db = 15.23077
Mean strength value of all re-bars: fy = 516.2752
ψt = 1.16154
ψs = 0.80
ψe = 1.00
cb = 25.00
Ktr = 2.64216
n = 13.00

- 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 = 0.30156355
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 2.4539832E-022
- Stirrup Spacing <= d/2
d = d_external = 357.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 209999.267,already given in calculation of shear control ratio
design Shear = 7.9342457E-015
- (ρ-ρ')/ρbal = -0.27560034
ρ = Aslt/(bw*d) = 0.00296835
Tension Reinf Area: Aslt = 709.9999
ρ' = Aslc/(bw*d) = 0.00697431
Compression Reinf Area: Aslc = 1668.186
From (B-1), ACI 318-11: ρbal = 0.0145354
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 28.14925
fy = fy_jacket_bars = 555.56
From 10.2.7.3, ACI 318-11: β1 = 0.65
From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+εy) = 0.51922877
εy = 0.0027778
- V/(bw*d*fc^0.5) = 7.5292621E-020, NOTE: units in lb & in
bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)