# Detailed Member Calculations

**Units: N&mm**

**Regulation: ASCE 41-17**

## Calculation No. 1

beam B1, Floor 1

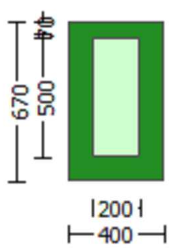
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

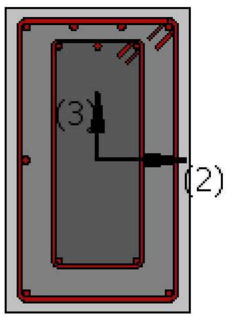
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00

Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.5808831E-010
Shear Force, Va = -8.4049242E-014
EDGE -B-
Bending Moment, Mb = -9.4153455E-011
Shear Force, Vb = 8.4049242E-014
BOTH EDGES
Axial Force, F = -4363.489
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
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-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 339071.608
Vn ((22.5.1.1), ACI 318-14) = 339071.608
-----------------------------------------------------------------
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 = 171520.00
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 1.5808831E-010
Vu = 8.4049242E-014
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 = 500.00
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 <= 712133.705
-----------------------------------------------------------------
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

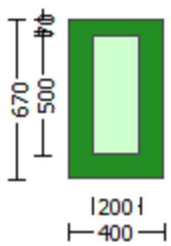
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

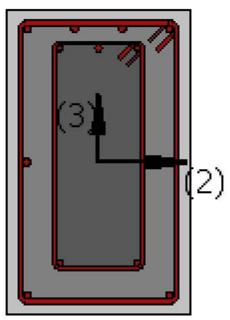
Analysis: Uniform +X

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

Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, is the shear force acting at edge 2 for the the static loading combination

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Calculation of Mu1+
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Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
---------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45

εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
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Calculation of ratio lb/ld
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Adequate Lap Length: lb/ld >= 1
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Calculation of Mu1-
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Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025

εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied

--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
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Calculation of ratio lb/ld
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Adequate Lap Length: lb/ld >= 1
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---------------------------------------------------------------------------------
Calculation of Mu2+
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Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889

ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
----------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
----------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
-------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars

Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345

ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu1-
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu2+
-------------------------------------------------------------------------

-------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
-------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344

N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908

----------------------------------------------------------------------

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00

d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008

ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
----------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
----------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = 1.1047E+007
Shear Force, V2 = -8.4049242E-014
Shear Force, V3 = 859.7793
Axial Force, F = -4363.489
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.01674201
θu = θy + θp = 0.01674201

---------------------------------------------------------------

- Calculation of θy -
---------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.00674201 ((4.29),Biskinis Phd))
My = 2.7374E+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 = 8.1204E+013
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
---------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.4349766E-006
with fy = 555.56
d = 627.00
ξy = 0.18485333
A = 0.00951372
B = 0.00406512
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 4363.489
b = 400.00
δ'' = 0.06858054
Φy_comp = 1.9036374E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.18432314
A = 0.00944286
B = 0.0040338
with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
- Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.01
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.90705729
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 6.1436951E-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 = 386302.632,already given in calculation of shear control ratio
design Shear = 859.7793
- (ρ-ρ')/ρbal = -0.22420649
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 0.00718664, 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

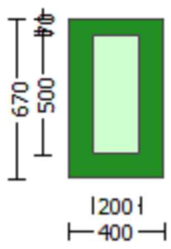
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

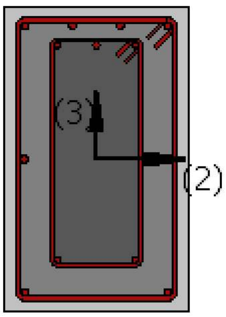
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00

New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = 1.1047E+007
Shear Force, Va = 859.7793
EDGE -B-
Bending Moment, Mb = 1.5895E+007
Shear Force, Vb = 18821.487
BOTH EDGES
Axial Force, F = -4363.489
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 486182.768
Vn ((22.5.1.1), ACI 318-14) = 486182.768
-----------------------------------------------------------------
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 = 172023.503
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 0.04171521
Mu = 1.1047E+007
Vu = 859.7793
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 314159.265
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 = 33510.322 is calculated for core, with:
d = 400.00
Av = 100530.965

fy = 500.00
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 <= 712133.705
---------------------------------------------------------------
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

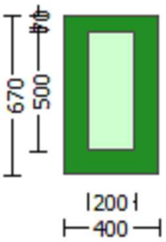
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

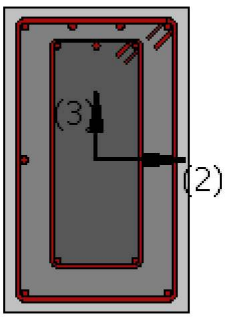
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00

New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------

Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45

εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008

φu = φsu (4.1) = 5.9367084E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446

λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
----------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture

δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
-------------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
###################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
###################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections

Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
-----------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
---------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345

ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002

Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344

N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477

λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = -1.5808831E-010
Shear Force, V2 = -8.4049242E-014
Shear Force, V3 = 859.7793
Axial Force, F = -4363.489
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0084424
θu = θy + θp = 0.0084424

---------------------------------------------------------------
 - Calculation of θy -
---------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.0034424 ((4.29),Biskinis Phd))

My = 1.9927E+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 = 2.8943E+013
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
---------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.0021098E-005
with fy = 555.56
d = 357.00
ξy = 0.22354295
A = 0.0099755
B = 0.00560296
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 4363.489
b = 670.00
δ'' = 0.12044818
Φy_comp = 2.7617879E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.22313777
A = 0.0099012
B = 0.00557012
with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
- Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.005
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.53480887
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.5731932E-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 = 215957.134,already given in calculation of shear control ratio
design Shear = 8.4049242E-014
- (ρ-ρ')/ρbal = -0.23508921
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 7.3664296E-019, 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

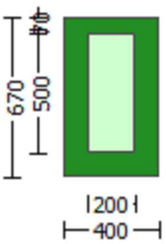
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

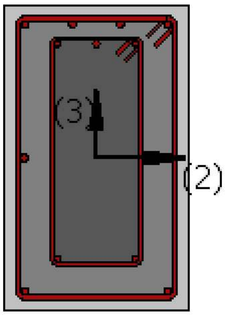
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.5808831E-010
Shear Force, Va = -8.4049242E-014
EDGE -B-
Bending Moment, Mb = -9.4153455E-011
Shear Force, Vb = 8.4049242E-014
BOTH EDGES
Axial Force, F = -4363.489
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 339071.608
Vn ((22.5.1.1), ACI 318-14) = 339071.608
-----------------------------------------------------------------
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 = 171520.00
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 9.4153455E-011
Vu = 8.4049242E-014
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 = 500.00
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 <= 712133.705
------------------------------------------------------------
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

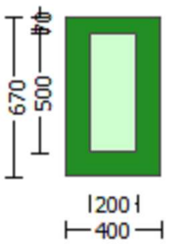
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

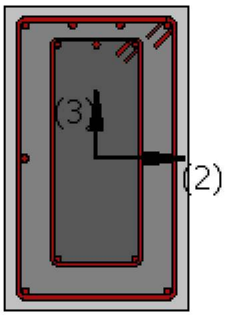
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################

Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
###############################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------

Calculation of Mu1-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld

--------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
Calculation of Mu2+
-----------------------------------------------------------------------------

-----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
-----------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34

fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005

```
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------------


----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
----------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.00027032
     N = 2237.255
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.00650345
     ωwe (5.4c) = 0.00563796
        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) = 1.25908
     --------------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
           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 = 1.25908
           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 = 694.45
        fce  = 33.00
     From ((5.A5), TBDY), TBDY: εcc = 0.00232446
        λc  = confinement factor = 1.03245
```

εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->

v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633

From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336

-------------------------------------------------------------
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, $\kappa$ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

-------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc  = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008

ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu1-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld

----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796

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) = 1.25908
----------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00

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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = 1.5895E+007
Shear Force, V2 = 8.4049242E-014
Shear Force, V3 = 18821.487
Axial Force, F = -4363.489
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.01094898
θu = θy + θp = 0.01094898

---------------------------------------------------------------
- Calculation of θy -
---------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.00094898 ((4.29),Biskinis Phd))
My = 2.7374E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 844.5373
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 8.1204E+013
---------------------------------------------------------------

---------------------------------------------------------------

Calculation of Yielding Moment My

---------------------------------------------------------------

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

---------------------------------------------------------------

Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.4349766E-006
with fy = 555.56
d = 627.00
ξy = 0.18485333
A = 0.00951372
B = 0.00406512
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 4363.489
b = 400.00
δ'' = 0.06858054
Φy_comp = 1.9036374E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.18432314
A = 0.00944286
B = 0.0040338
with Es = 200000.00

---------------------------------------------------------------

Calculation of ratio lb/ld

---------------------------------------------------------------

Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------

- Calculation of θp -

---------------------------------------------------------------

From table 10-7: θp = 0.01
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.90705729
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 9.5960011E-006
- Stirrup Spacing <= d/2
d = d_external = 627.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 386302.632,already given in calculation of shear control ratio
design Shear = 18821.487
- (ρ-ρ')/ρbal = -0.22420649
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 0.15732316, 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

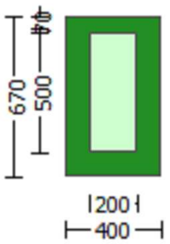
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

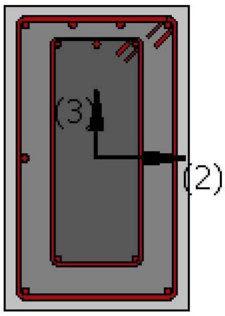
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
----------------------------------------------------------------

Stepwise Properties
----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = 1.1047E+007
Shear Force, Va = 859.7793
EDGE -B-
Bending Moment, Mb = 1.5895E+007
Shear Force, Vb = 18821.487
BOTH EDGES
Axial Force, F = -4363.489
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
----------------------------------------------------------------
----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 493339.696
Vn ((22.5.1.1), ACI 318-14) = 493339.696
----------------------------------------------------------------
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 = 179180.43
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 0.63466702
Mu = 1.5895E+007
Vu = 18821.487
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 314159.265
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 = 33510.322 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 500.00
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 <= 712133.705
----------------------------------------------------------------

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

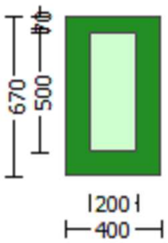
Limit State: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

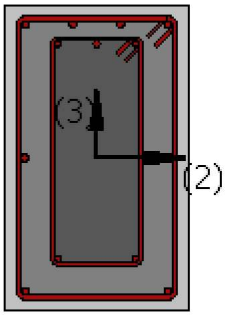
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket

New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005

Mu = 4.3734E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld

----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------

---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------

Calculation of ratio lb/ld

----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34

fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202

Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
-----------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
-----------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
-----------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------
At local axis: 2

EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu1-
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
---------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008

ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc  = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796

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) = 1.25908
----------------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.

Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
Bending Moment, M = -9.4153455E-011
Shear Force, V2 = 8.4049242E-014
Shear Force, V3 = 18821.487
Axial Force, F = -4363.489
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
-------------------------------------------------------------
-------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0084424
θu = θy + θp = 0.0084424

-------------------------------------------------------------
- Calculation of θy -
-------------------------------------------------------------
θy = (My*Ls/3)/Eleff = 0.0034424 ((4.29),Biskinis Phd))
My = 1.9927E+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 = 2.8943E+013
-------------------------------------------------------------
-------------------------------------------------------------

Calculation of Yielding Moment My

---------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
---------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.0021098E-005
 with fy = 555.56
  d = 357.00
  ξy = 0.22354295
  A = 0.0099755
  B = 0.00560296
   with pt = 0.00380895
    pc = 0.00380895
    pv = 0.00232477
    N = 4363.489
    b = 670.00
    δ'' = 0.12044818
Φy_comp = 2.7617879E-005
 with fc = 33.00
  Ec = 26999.444
  ξy = 0.22313777
  A = 0.0099012
  B = 0.00557012
   with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
 - Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.005
with:
 - Condition i occured
  Beam controlled by flexure: Vp/Vo <= 1
  shear control ratio Vp/Vo = 0.53480887
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
   θ = 4.3544309E-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 = 215957.134,already given in calculation of shear control ratio
  design Shear = 8.4049242E-014
 - (ρ-ρ')/ρbal = -0.23508921
  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 = 0.01704017
   fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
   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) = 7.3664296E-019, 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

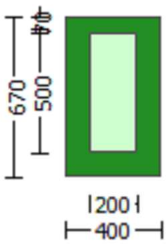
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

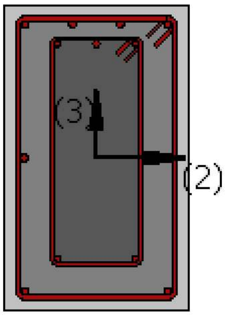
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member

Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.0550018E-010
Shear Force, Va = -5.6924552E-014
EDGE -B-
Bending Moment, Mb = -6.5336195E-011
Shear Force, Vb = 5.6924552E-014
BOTH EDGES
Axial Force, F = -3615.233
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 339071.608
Vn ((22.5.1.1), ACI 318-14) = 339071.608
-----------------------------------------------------------------
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 = 171520.00
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 1.0550018E-010
Vu = 5.6924552E-014
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 = 500.00
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 <= 712133.705
-----------------------------------------------------------------
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

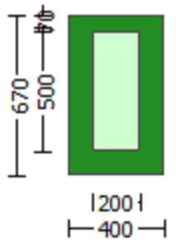
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

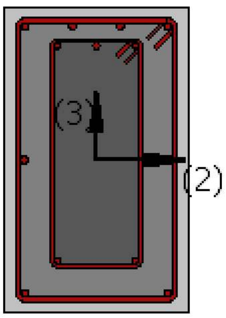
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
################################################################

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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
-----------------------------------------------------------------------------
with full section properties:
b = 400.00

d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008

ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu1-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008

---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45

with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005
Mu = 4.3734E+008
----------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------
------------------------------------------------------------------------

-----------------------------------------------------------------------------
Calculation of Mu2-
-----------------------------------------------------------------------------

-----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
-----------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
---------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
---------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
---------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
-----------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015

BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00

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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908

-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34

fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc  = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00

εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336

---------------------------------------------------------------------------

Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336

---------------------------------------------------------------

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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00

New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
Bending Moment, M = 6.8008E+006
Shear Force, V2 = -5.6924552E-014
Shear Force, V3 = 4020.289
Axial Force, F = -3615.233
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.05189937
θu = θy + θp = 0.05189937

-----------------------------------------------------------------
- Calculation of θy -
-----------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.00189937 ((4.29),Biskinis Phd))
My = 2.7353E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1691.607
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 8.1204E+013
-----------------------------------------------------------------
-----------------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
-----------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)

Φy_ten = 5.4341296E-006
with fy = 555.56
d = 627.00
ξy = 0.18472628
A = 0.00950835
B = 0.00405975
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 3615.233
b = 400.00
δ'' = 0.06858054
Φy_comp = 1.9040134E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.18428673
A = 0.00944964
B = 0.0040338
with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
- Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.05
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.90705729
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 4.7230116E-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 = 386302.632,already given in calculation of shear control ratio
design Shear = 4020.289
- (ρ-ρ')/ρbal = -0.22420649
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 0.03360439, 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

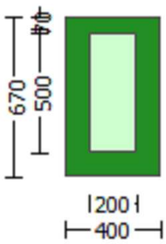
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

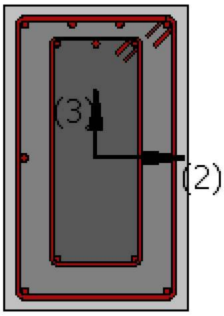
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections

Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = 6.8008E+006
Shear Force, Va = 4020.289
EDGE -B-
Bending Moment, Mb = 1.0660E+007
Shear Force, Vb = 15660.977
BOTH EDGES
Axial Force, F = -3615.233
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 489503.746
Vn ((22.5.1.1), ACI 318-14) = 489503.746
---------------------------------------------------------------
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 = 175344.48
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 0.31685838
Mu = 6.8008E+006
Vu = 4020.289
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 314159.265
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 = 33510.322 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 500.00
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 <= 712133.705
---------------------------------------------------------------
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

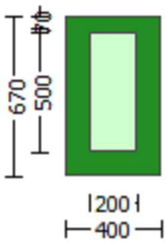
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

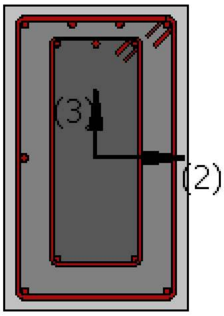
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255

fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00

d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34

fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005

Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2-
------------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------------------------

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56

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 <= 818179.336
-----------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu1-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45

εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
--------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
----------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column

New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
Bending Moment, M = -1.0550018E-010
Shear Force, V2 = -5.6924552E-014
Shear Force, V3 = 4020.289
Axial Force, F = -3615.233
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.03344037
θu = θy + θp = 0.03344037

-----------------------------------------------------------------
- Calculation of θy -
-----------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.00344037 ((4.29),Biskinis Phd))
My = 1.9915E+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 = 2.8943E+013
-----------------------------------------------------------------
-----------------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
-----------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.0019693E-005
with fy = 555.56
d = 357.00
ξy = 0.22343403

A = 0.00996987
B = 0.00559733
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 3615.233
b = 670.00
δ'' = 0.12044818
Φy_comp = 2.7622785E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.22309813
A = 0.00990831
B = 0.00557012
with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
- Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.03
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.53480887
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 9.9381411E-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 = 215957.134,already given in calculation of shear control ratio
design Shear = 5.6924552E-014
- (ρ-ρ')/ρbal = -0.23508921
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 4.9891075E-019, 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

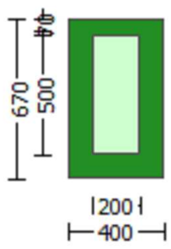
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

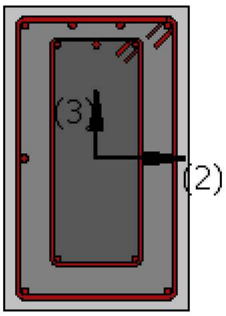
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections

Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.0550018E-010
Shear Force, Va = -5.6924552E-014
EDGE -B-
Bending Moment, Mb = -6.5336195E-011
Shear Force, Vb = 5.6924552E-014
BOTH EDGES
Axial Force, F = -3615.233
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 339071.608
Vn ((22.5.1.1), ACI 318-14) = 339071.608
-----------------------------------------------------------------
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 = 171520.00
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 6.5336195E-011
Vu = 5.6924552E-014
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 = 500.00
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 <= 712133.705
-----------------------------------------------------------------
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

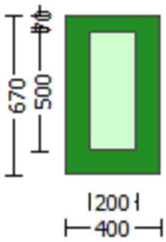
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

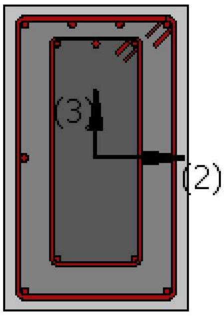
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
##################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
-------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255

fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
--------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00

d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34

fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005

Mu = 4.3734E+008
-------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
---------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56

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 <= 818179.336
--------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
##############################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Mu1-
-----------------------------------------------------------------

-----------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
-----------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-----------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
----------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
---------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45

εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc  = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336

---

Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336

---

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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column

New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
-----------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------------
Bending Moment, M = 1.0660E+007
Shear Force, V2 = 5.6924552E-014
Shear Force, V3 = 15660.977
Axial Force, F = -3615.233
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
-----------------------------------------------------------------
-----------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.0507643
θu = θy + θp = 0.0507643

-----------------------------------------------------------------
- Calculation of θy -
-----------------------------------------------------------------
θy = (My*Ls/3)/Eleff = 0.0007643 ((4.29),Biskinis Phd))
My = 2.7353E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 680.6998
From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 8.1204E+013
-----------------------------------------------------------------
-----------------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
-----------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 5.4341296E-006
with fy = 555.56
d = 627.00
ξy = 0.18472628

A = 0.00950835
B = 0.00405975
with pt = 0.00283094
pc = 0.00504809
pv = 0.00160336
N = 3615.233
b = 400.00
δ" = 0.06858054
Φy_comp = 1.9040134E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.18428673
A = 0.00944964
B = 0.0040338
with Es = 200000.00
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

------------------------------------------------------------
- Calculation of θp -
------------------------------------------------------------
From table 10-7: θp = 0.05
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.90705729
- Transverse Reinforcement: C
- Stirrup Spacing <= d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = -1.1948219E-006
- Stirrup Spacing <= d/2
d = d_external = 627.00
s = s_external = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
Vs = 386302.632,already given in calculation of shear control ratio
design Shear = 15660.977
- (ρ-ρ')/ρbal = -0.22420649
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 0.13090541, 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

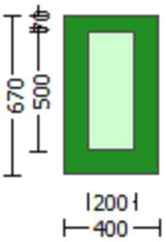
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

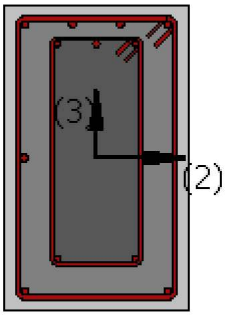
Analysis: Uniform +X

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 = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections

Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = 6.8008E+006
Shear Force, Va = 4020.289
EDGE -B-
Bending Moment, Mb = 1.0660E+007
Shear Force, Vb = 15660.977
BOTH EDGES
Axial Force, F = -3615.233
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
------------------------------------------------------------
------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 495183.483
Vn ((22.5.1.1), ACI 318-14) = 495183.483
------------------------------------------------------------
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 = 181024.218
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 25.00, 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 = 0.78742491
Mu = 1.0660E+007
Vu = 15660.977
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 314159.265
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 = 33510.322 is calculated for core, with:
d = 400.00
Av = 100530.965
fy = 500.00
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 <= 712133.705
------------------------------------------------------------
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

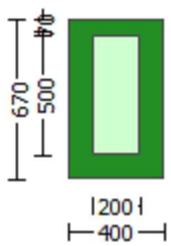
Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

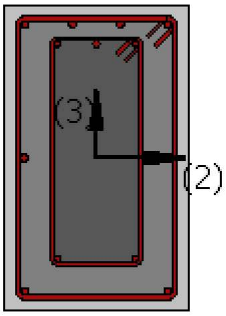
Analysis: Uniform +X

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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
###################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
###################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 9840.633
EDGE -B-
Shear Force, Vb = 9840.633
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.90705729
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 = 506319.489
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.4472E+008
Mu1+ = 4.3734E+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- = 7.4472E+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-) = 7.4472E+008
Mu2+ = 4.3734E+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- = 7.4472E+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 = 9840.633, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.633, 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 = 5.6088283E-005
Mu = 4.3734E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255

fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Calculation of Mu1-
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
-------------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00

d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34

fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Calculation of Mu2+
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.6088283E-005

Mu = 4.3734E+008
-----------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05957415
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.10623177
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0736092
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.13125889
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.09006517
Mu = MRc (4.14) = 4.3734E+008
φu = φsu (4.1) = 5.6088283E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 5.9367084E-005
Mu = 7.4472E+008
---------------------------------------------------------------------------
with full section properties:
b = 400.00
d = 627.00
d' = 43.00
v = 0.00027032
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
---------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10623177
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.05957415
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.03374111
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.13125889
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.0736092
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04169017
Case/Assumption: Unconfinesd full section - Steel rupture
δ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.8) = 0.1403202
Mu = MRc (4.15) = 7.4472E+008
φu = φsu (4.1) = 5.9367084E-005
----------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------------------

---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 558200.119
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d2 = 400.00
Av = 100530.965
fy = 555.56
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 <= 818179.336
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 558200.119
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 = 209131.476
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.0197E+006
Vu = 9840.633
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 349068.643
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 = 37233.989 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 555.56

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 <= 818179.336
-------------------------------------------------------------
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 = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Jacket
New material: Steel Strength, fs = 1.25*fsm = 694.45
Existing Column
New material: Steel Strength, fs = 1.25*fsm = 694.45
#################################################################
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 = 1.03245
Element Length, L = 3000.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = -6.9721474E-015
EDGE -B-
Shear Force, Vb = 6.9721474E-015
BOTH EDGES
Axial Force, F = -2237.255
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 = 0.53480887
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 = 204955.561
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0743E+008
Mu1+ = 3.0743E+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- = 3.0743E+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-) = 3.0743E+008
Mu2+ = 3.0743E+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- = 3.0743E+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 = -6.9721474E-015, is the shear force acting at edge 1 for the the static loading combination
V2 = 6.9721474E-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 = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
--------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------------

------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
----------------------------------------------------------------------

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45
εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------------------
----------------------------------------------------------------------------------
----------------------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------------------

----------------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
φu = 0.00010406
Mu = 3.0743E+008
----------------------------------------------------------------------------------
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
v = 0.00028344
N = 2237.255
fc = 33.00
εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu,εcc) = 0.00650345
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: εcu = 0.00650345
ωwe (5.4c) = 0.00563796
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) = 1.25908
-------------------------------------------------------------------
psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.25223
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 = 1.25908
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 = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00232446
λc = confinement factor = 1.03245
εy1 = 0.0025
εsh1 = 0.008
ft1 = 833.34
fy1 = 694.45
εsu1 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
εy2 = 0.0025
εsh2 = 0.008
ft2 = 833.34
fy2 = 694.45
εsu2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
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 = 694.45
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
εyv = 0.0025
εshv = 0.008
ftv = 833.34
fyv = 694.45

εsuv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
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 = 694.45
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08015524
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.08015524
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.04892233
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.07073
εcc (5A.5, TBDY) = 0.00232446
λc = confinement factor = 1.03245
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09611636
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09611636
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05866412
Case/Assumption: Unconfinesd full section - Steel rupture
δ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
ξsu (4.9) = 0.13857861
Mu = MRc (4.14) = 3.0743E+008
φu = φsu (4.1) = 0.00010406
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 383231.42
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 8.6547052E-012
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 383231.42
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 = 197061.477
λ = 1 (normal-weight concrete)
Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 33.00, 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 = 1.2266780E-011
Vu = 6.9721474E-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 = 555.56
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 <= 818179.336
-------------------------------------------------------------
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 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Existing Column

New material of Primary Member: Concrete Strength, fc = fcm = 33.00
New material of Primary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
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
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = -6.5336195E-011
Shear Force, V2 = 5.6924552E-014
Shear Force, V3 = 15660.977
Axial Force, F = -3615.233
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0*θu = 0.03344037
θu = θy + θp = 0.03344037

---------------------------------------------------------------
- Calculation of θy -
---------------------------------------------------------------
θy = (My*Ls/3)/EIeff = 0.00344037 ((4.29),Biskinis Phd))
My = 1.9915E+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 = 2.8943E+013
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of Φy and My according to Annex 7A - ΚΑΝΕΠΕ
---------------------------------------------------------------
Φy = Min(Φy_ten,Φy_com)
Φy_ten = 1.0019693E-005
with fy = 555.56
d = 357.00
ξy = 0.22343403

A = 0.00996987
B = 0.00559733
with pt = 0.00380895
pc = 0.00380895
pv = 0.00232477
N = 3615.233
b = 670.00
δ'' = 0.12044818
Φy_comp = 2.7622785E-005
with fc = 33.00
Ec = 26999.444
ξy = 0.22309813
A = 0.00990831
B = 0.00557012
with Es = 200000.00
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1

---------------------------------------------------------------
- Calculation of θp -
---------------------------------------------------------------
From table 10-7: θp = 0.03
with:
- Condition i occured
Beam controlled by flexure: Vp/Vo <= 1
shear control ratio Vp/Vo = 0.53480887
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, θ/θy < 2 (table 10-6, ASCE 41-17)
θ = 1.7139944E-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 = 215957.134,already given in calculation of shear control ratio
design Shear = 5.6924552E-014
- (ρ-ρ')/ρbal = -0.23508921
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 = 0.01704017
fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 33.00
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) = 4.9891075E-019, 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)

---------------------------------------------------------------