Detailed Member Calculations

Units: N&mm

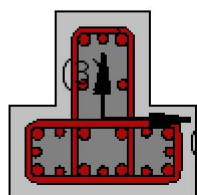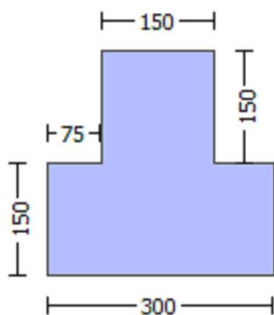**Regulation: ASCE 41-17**

Calculation No. 1

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor, = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -1.9905E+008
Shear Force, Va = -40180.701
EDGE -B-
Bending Moment, Mb = -8.2820E+006
Shear Force, Vb = 40180.701
BOTH EDGES
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 2375.044
    -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 1231.504
    -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104464.968
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122899.962
   VCol = 122899.962
   knl = 1.00
      displacement_ductility_demand = 1.04358

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 1.9905E+008
     Vu = 40180.701
  d = 0.8*h = 240.00
  Nu = 808455.076
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
  where:
  Vs1 = 0.00 is calculated for section web, with:
     d = 120.00

```
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 66138.793 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 95659.751
    bw = 150.00
-------------------------------------------------------------

-------------------------------------------------------------
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END A -
 for rotation axis 3 and integ. section (a)
-------------------------------------------------------------
From analysis, chord rotation    = 0.03580984
  y = (My*Ls/3)/Eleff = 0.03431445 ((4.29),Biskinis Phd))
  My = 1.1609E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 4953.985
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.5865E+012
    factor = 0.70
      Ag = 67500.00
      fc' = 20.00
      N = 808455.076
    Ec*Ig = 7.9807E+012
-------------------------------------------------------------
-------------------------------------------------------------

Calculation of Yielding Moment My
-------------------------------------------------------------
Calculation of   y and My according to Annex 7   -
-------------------------------------------------------------
  y = Min(  y_ten,  y_com)
  y_ten = 2.1133425E-005
 with fy = 444.44
    d = 257.00
     y = 0.59085228
    A = 0.18083668
    B = 0.12519247
     with pt = 0.03194564
        pc = 0.03194564
        pv = 0.06975884
        N = 808455.076
        b = 150.00
        " = 0.16731518
  y_comp = 9.3780169E-006
 with fc = 20.00
    Ec = 21019.039
     y = 0.71063323
    A = 0.0724275
    B = 0.0780059
     with Es = 200000.00
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
```

At local axis: 2
Integration Section: (a)

Calculation No. 2

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00

Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
         -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
   Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
   Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
        we (5.4c) = 0.00

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
    The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
    of the rectangular sections confinement, which is expressed by (5.4d).
    The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
    "Theoretical Stress-Strain Model for Confined Concrete."
    J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
    Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
        is calculated as the area of core enclosed by the center lines of the perimeter hoops.
    Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
        is calculated by reducing all the dimensions of the area Aconf,max by a length
        equal to half the clear spacing between hoops.
    AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

----

psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
    Lstir (Length of stirrups along Y) = 660.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 67500.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
    Lstir (Length of stirrups along X) = 660.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 67500.00

----

    s = 190.00
    fywe = 555.55
    fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
    c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55

suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value f_{syv} = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and ϵ_{yv}, shv,ftv,fyv, it is considered
   characteristic value f_{syv} = fsv/1.2, from table 5.1, TBDY.
   ϵ_{y1}, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  ω_1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
  ω_2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
  ω_v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  ϵ_{cc} (5A.5, TBDY) = 0.002
   c = confinement factor = 1.00
  ω_1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
  ω_2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
  ω_v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < $\omega_{s,y1}$ - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
ϕ_{cu} (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω_1, ω_2, ω_v normalised to bo*do, instead of b*d
  - ϵ - parameters of confined concrete, fcc, ϵ_{cc}, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
ϕ*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->

  u = cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
            is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
            is calculated by reducing all the dimensions of the area Aconf,max by a length
            equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
     ----
     psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
       Lstir (Length of stirrups along Y) = 660.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 67500.00
     ----
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
       Lstir (Length of stirrups along X) = 660.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 67500.00
     ----
       s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
   sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
   su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479
   shv = 0.008
 ftv = 666.66
 fyv = 555.55
   suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
   2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
   v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied

--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N, 1, 2, v normalised to bo*do, instead of b*d
   -   - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
       we (5.4c) = 0.00
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.

Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without earthquake detailing (90° closed stirrups)
----

psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----

s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fsv = fs = 555.55
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
   2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
   v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N,   1,   2,   v normalised to bo*do, instead of b*d
   -   - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 1.7570028E-005
Mu = MRc

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 = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  ν = 0.52445308
    N = 808706.655
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00

      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: εcc = 0.002
        αc = confinement factor = 1.00
   εy1 = 0.00231479
   εsh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
   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 = 555.55
        with Es1 = Es = 200000.00
    y2 = 0.00231479
    sh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55
    su2 = 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
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 555.55
        with Es2 = Es = 200000.00
    yv = 0.00231479
    shv = 0.008
  ftv = 666.66
  fyv = 555.55
    suv = 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
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 555.55
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
    2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
    v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
    2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
    v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made

- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
$v^* < v^*_{s,y2}$ - LHS eq.(4.5) is not satisfied
--->
$v^* < v^*_{s,c}$ - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
$v^* < v^*_{c,y2}$ - LHS eq.(4.6) is not satisfied
--->
$v^* < v^*_{c,y1}$ - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 538989.858
     Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 106950.853
   bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 535.426
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00

Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
      -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
   Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
   Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
   b = 150.00
   d = 257.00
   d' = 43.00
   v = 1.04891
      N = 808706.655
   fc = 20.00

co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
       The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
       of the rectangular sections confinement, which is expressed by (5.4d).
       The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
       "Theoretical Stress-Strain Model for Confined Concrete."
       J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
       Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
          is calculated as the area of core enclosed by the center lines of the perimeter hoops.
       Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
          is calculated by reducing all the dimensions of the area Aconf,max by a length
          equal to half the clear spacing between hoops.
       AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
     ----
     psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
       Lstir (Length of stirrups along Y) = 660.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 67500.00
     ----
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
       Lstir (Length of stirrups along X) = 660.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 67500.00
     ----
       s = 190.00
       fywe = 555.55
       fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55

with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
 2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
 v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
 b = 90.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
   c = confinement factor = 1.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
 2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
 v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N,   1,   2,   v normalised to bo*do, instead of b*d
 -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied

--->
 *εcu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 εu = εcu (unconfined full section) = 2.0683116E-005
Mu = MRc

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 = 2.0683116E-005
 Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  ν = 1.04891
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

        ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00

        ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
        ----
          s = 190.00
         fywe = 555.55
         fce = 20.00
      From ((5.A5), TBDY), TBDY: εcc = 0.002
          αc = confinement factor = 1.00
   εy1 = 0.00231479

sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
 y2 = 0.00231479
  sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
 yv = 0.00231479
  shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.

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--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization

of the rectangular sections confinement, which is expressed by (5.4d).
The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
"Theoretical Stress-Strain Model for Confined Concrete."
J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
is calculated as the area of core enclosed by the center lines of the perimeter hoops.
Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

----
psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----
s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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

$l_o/l_{ou,min} = l_b/l_d = 1.00$

$s_{uv} = 0.4 * \varepsilon_{suv\_nominal} ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $\varepsilon_{suv\_nominal} = 0.08$,

considering characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY

For calculation of $\varepsilon_{suv\_nominal}$ and ε_{yv}, $\varepsilon_{hv}, f_{tv}, f_{yv}$, it is considered

characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY.

ε_{y1}, $\varepsilon_{sh1}, f_{t1}, f_{y1}$, are also multiplied by Min(1,1.25*(l_b/l_d)^2/3), from 10.3.5, ASCE 41-17.

with $f_{sv} = f_s = 555.55$

with $E_{sv} = E_s = 200000.00$

$\omega_1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.88736994$

$\omega_2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.88736994$

$\omega_v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 1.93773$

and confined core properties:

$b = 90.00$

$d = 227.00$

$d' = 13.00$

f_{cc} (5A.2, TBDY) = 20.00

ε_{cc} (5A.5, TBDY) = 0.002

λ_c = confinement factor = 1.00

$\omega_1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 1.67441$

$\omega_2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 1.67441$

$\omega_v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 3.65636$

Case/Assumption: Unconfinesd full section - Steel rupture

' does not satisfy Eq. (4.3)

--->

$v < v_{s,c}$ - RHS eq.(4.5) is not satisfied

--->

Case/Assumption Rejected.

--->

New Case/Assumption: Unconfinesd full section - Spalling of concrete cover

' satisfies Eq. (4.4)

--->

$v < \omega_{s,y1}$ - LHS eq.(4.7) is not satisfied

--->

$v < v_{c,y1}$ - RHS eq.(4.6) is not satisfied

--->

φ_{cu} (4.11) = 0.65844416

M_{Rc} (4.18) = 2.0480E+008

--->

New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover

In expressions below, the following modifications have been made

- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
- N, ω_1, ω_2, ω_v normalised to bo*do, instead of b*d
- ε - parameters of confined concrete, f_{cc}, ε_{cc}, used in lieu of fc, ecu

--->

Subcase: Rupture of tension steel

--->

$v^* < v^*_{s,y2}$ - LHS eq.(4.5) is not satisfied

--->

$v^* < v^*_{s,c}$ - LHS eq.(4.5) is not satisfied

--->

Subcase rejected

--->

New Subcase: Failure of compression zone

--->

$v^* < v^*_{c,y2}$ - LHS eq.(4.6) is not satisfied

--->

$v^* < v^*_{c,y1}$ - RHS eq.(4.6) is not satisfied

--->

φ^*_{cu} (4.11) = 0.66611064

M_{Ro} (4.18) = 1.4457E+008

$M_{Ro} < 0.8*M_{Rc}$

--->

$\varphi_u = \varphi_{cu}$ (unconfined full section) = 2.0683116E-005

$M_u = M_{Rc}$

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
  su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
  su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
  suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
b = 90.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied

--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 786.7782
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:

```
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
    Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf < = 106950.853
      bw = 150.00
---------------------------------------------------------------
----------------------------------------------------------------
```

Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

```
---------------------------------------------------------------
```
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
```
---------------------------------------------------------------
```
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 1.10406
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf < = 106950.853
    bw = 150.00


```
End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

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

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rctcs

Constant Properties
```
---------------------------------------------------------------
```
Knowledge Factor, = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44

Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -2.2670E+006
Shear Force, V2 = -40180.701
Shear Force, V3 = -407.0034
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 2375.044
     -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
      -Compression: Asl,com = 829.3805
         -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = * u = 0.03815549
 u = y + p = 0.04488881

 - Calculation of y -
----
 y = (My*Ls/3)/EIeff = 0.04488881 ((4.29),Biskinis Phd))
  My = 1.6508E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 5570.02
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 6.8279E+012
     factor = 0.70
        Ag = 67500.00
        fc' = 20.00
        N = 808455.076
     Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -

Assuming neutral axis out of flange (y > t/d, compression zone NOT rectangular)
extended expressions (2.1)-(2.7) of Biskinis-Fardis (2009) are adopted with:
flange width, b = 300.00
web width, bw = 150.00
flange thickness, t = 150.00
----
 y = Min(y_ten, y_com)
  y_ten = 2.0656411E-005
 with fy = 444.44

```
     d = 257.00
      y = 0.58140393
      A = 0.24217629
      B = 0.15856494
       with pt = 0.00404182
           pc = 0.0107572
           pv = 0.02673002
           N = 808455.076
           b = 300.00
            " = 0.16731518
   y_comp = 1.0082257E-005
 with fc = 20.00
     Ec = 21019.039
      y = 0.66099589
      A = 0.13376711
      B = 0.11137837
       with Es = 200000.00
CONFIRMATION:  y = 0.66099589 > t/d
------------------------------------------------------------

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


------------------------------------------------------------
 - Calculation of  p -
------------------------------------------------------------
From table 10-8:  p = 0.00
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VCol0E = 1.21438
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises  f to steel strength
   All these variables have already been given in Shear control ratio calculation.
     NUD = 808455.076
     Ag = 67500.00
     f'cE = 20.00
     fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.06682506
   b = 300.00
   d = 257.00
    f'cE = 20.00
------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)


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

Calculation No. 3

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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

```
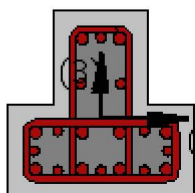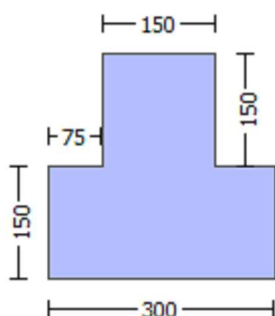------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -2.2670E+006
Shear Force, Va = -407.0034
EDGE -B-
Bending Moment, Mb = 497313.962
Shear Force, Vb = 407.0034
BOTH EDGES
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 2375.044
    -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
       -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778
------------------------------------------------------------
------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104464.968
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122899.962
  VCol = 122899.962
  knl = 1.00
      displacement_ductility_demand = 0.02748888
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 2.2670E+006
    Vu = 407.0034
  d = 0.8*h = 240.00
  Nu = 808455.076
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
  where:
  Vs1 = 66138.793 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 95659.751
    bw = 150.00
------------------------------------------------------------


------------------------------------------------------------
displacement_ductility_demand is calculated as   /  y

 - Calculation of   /  y for END A -
 for rotation axis 2 and integ. section (a)
------------------------------------------------------------
From analysis, chord rotation    = 0.00123394
 y = (My*Ls/3)/Eleff = 0.04488881 ((4.29),Biskinis Phd))
```

My = 1.6508E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 5570.02
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 6.8279E+012
  factor = 0.70
    Ag = 67500.00
    fc' = 20.00
    N = 808455.076
  Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -

Assuming neutral axis out of flange (y > t/d, compression zone NOT rectangular)
extended expressions (2.1)-(2.7) of Biskinis-Fardis (2009) are adopted with:
flange width, b = 300.00
web width, bw = 150.00
flange thickness, t = 150.00
----
  y = Min(y_ten, y_com)
  y_ten = 2.0656411E-005
 with fy = 444.44
   d = 257.00
    y = 0.58140393
   A = 0.24217629
   B = 0.15856494
   with pt = 0.02933783
     pc = 0.0107572
     pv = 0.02673002
     N = 808455.076
     b = 300.00
     " = 0.16731518
  y_comp = 1.0082257E-005
 with fc = 20.00
   Ec = 21019.039
    y = 0.66099589
   A = 0.13376711
   B = 0.11137837
   with Es = 200000.00
CONFIRMATION: y = 0.66099589 > t/d

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 4

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
   -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 2261.947
   -Compression: Asl,com = 829.3805
     -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
   Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
   Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
             is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
             is calculated by reducing all the dimensions of the area Aconf,max by a length
             equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without

earthquake detailing (90° closed stirrups)
```
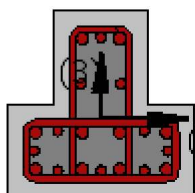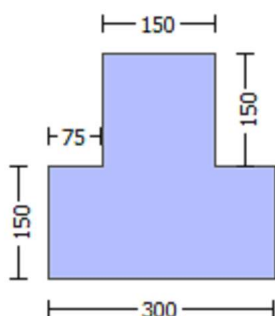    ----------------------------------------------------------------
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
    ----------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along X) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
    ----------------------------------------------------------------
           s = 190.00
         fywe = 555.55
         fce = 20.00
      From ((5.A5), TBDY), TBDY:  cc = 0.002
           c = confinement factor = 1.00
```
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986

2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
    v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
   2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N, 1, 2, v normalised to bo*do, instead of b*d
   - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 u = cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature ϕ_u according to 4.1, Biskinis/Fardis 2013:
  ϕ_u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   ε_{co} (5A.5, TBDY) = 0.002
  Final value of ε_{cu}: ε_{cu}^* = shear_factor * Max(ε_{cu}, ε_{cc}) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: ε_{cu} = 0.0035
      ω_{we} (5.4c) = 0.00
      α_{se} = Max((($A_{conf,max}$-AnoConf)/$A_{conf,max}$)*($A_{conf,min}$/$A_{conf,max}$),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
            is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
            is calculated by reducing all the dimensions of the area Aconf,max by a length
            equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to $\sum b_i^2/6$ as defined at (A.2).
      $\rho_{sh,min}$ = Min($\rho_{sh,x}$, $\rho_{sh,y}$) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      $\rho_{sh,x}$ ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00

      $\rho_{sh,y}$ ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5.A5), TBDY), TBDY: ε_{cc} = 0.002
        α_c = confinement factor = 1.00
  ε_{y1} = 0.00231479
  ε_{sh1} = 0.008
  ft1 = 666.66
  fy1 = 555.55
  ε_{su1} = 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
     ε_{su1} = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and ε_{y1}, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     ε_{y1}, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  ε_{y2} = 0.00231479
  ε_{sh2} = 0.008
  ft2 = 666.66
  fy2 = 555.55

su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
 2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
 v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
 b = 240.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
  2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
  v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->

v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182

```
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00

     -----------------------------------------------------------------
         s = 190.00
       fywe = 555.55
       fce  = 20.00
    From ((5.A5), TBDY):  cc = 0.002
        c  = confinement factor = 1.00
  y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
   2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
   v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
```

```
      c  = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
    2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -  parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
  *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) =  1.7570028E-005
Mu = MRc
------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----------------------------------------------------------------------
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
```

v = 0.52445308
  N = 808706.655
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.0035
    we (5.4c) = 0.00
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
      of the rectangular sections confinement, which is expressed by (5.4d).
      The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
      "Theoretical Stress-Strain Model for Confined Concrete."
      J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
      Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
        is calculated as the area of core enclosed by the center lines of the perimeter hoops.
      Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
        is calculated by reducing all the dimensions of the area Aconf,max by a length
        equal to half the clear spacing between hoops.
      AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00404182
  Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

    ----
    psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along Y) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along X) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
      s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
  su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
  su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
  2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
  v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
  2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
  v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1,   2, v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 538989.858
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 535.426
   Vu = 1.7373234E-005
d = 0.8*h = 240.00
Nu = 808706.655
Ag = 45000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
where:
Vs1 = 73486.813 is calculated for section web, with:
   d = 240.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs1 is multiplied by   Col1 = 0.83333333
   s/d = 0.79166667
Vs2 = 0.00 is calculated for section flange, with:
   d = 120.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs2 is multiplied by   Col2 = 0.00
   s/d = 1.58333
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 106950.853
   bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 1231.504
    -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
  Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
  Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
     N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                  is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and

is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
----
psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY): cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered

characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
  2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
  v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
          s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5A.5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
  su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55

with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
    2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
    v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o

- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
 b = 150.00
 d = 257.00
 d' = 43.00
 v = 1.04891
   N = 808706.655
 fc = 20.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

```
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
      -----------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along X) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
      -----------------------------------------------------------------
           s = 190.00
        fywe = 555.55
         fce = 20.00
     From ((5.A5), TBDY), TBDY:  cc = 0.002
           c = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
   yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
```

and confined core properties:
   b = 90.00
   d = 227.00
   d' = 13.00
   fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005

Mu = 2.0480E+008

----

with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.0035$
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
       The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
       of the rectangular sections confinement, which is expressed by (5.4d).
       The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
       "Theoretical Stress-Strain Model for Confined Concrete."
       J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
       Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
          is calculated as the area of core enclosed by the center lines of the perimeter hoops.
       Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
         is calculated by reducing all the dimensions of the area Aconf,max by a length
         equal to half the clear spacing between hoops.
       AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
    2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
    v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->

v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 786.7782
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077

knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ ɸf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

 ƛ = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 2.00
   Mu = 1.10406
   Vu = 9.8273208E-008
d = 0.8*h = 240.00
Nu = 808706.655
Ag = 45000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
where:
Vs1 = 0.00 is calculated for section web, with:
   d = 120.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs1 is multiplied by Col1 = 0.00
   s/d = 1.58333
Vs2 = 73486.813 is calculated for section flange, with:
   d = 240.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs2 is multiplied by Col2 = 0.83333333
   s/d = 0.79166667
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 106950.853
   bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor, ĸ = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -1.9905E+008
Shear Force, V2 = -40180.701
Shear Force, V3 = -407.0034
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 2375.044
  -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 1231.504
  -Compression: Asl,com = 1231.504
    -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R}$ = $\ast$ θ_u = 0.02950252
θ_u = θ_y + θ_p = 0.03470884

 - Calculation of θ_y -

 θ_y = (My*Ls/3)/EIeff = 0.03431445 ((4.29),Biskinis Phd))
 My = 1.1609E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 4953.985
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.5865E+012
   factor = 0.70
    Ag = 67500.00
    fc' = 20.00
    N = 808455.076
   Ec*Ig = 7.9807E+012

Calculation of Yielding Moment My

Calculation of ϕ_y and My according to Annex 7 -

 ϕ_y = Min(ϕ_{y_ten}, ϕ_{y_com})
 ϕ_{y_ten} = 2.1133425E-005
with fy = 444.44
   d = 257.00
   ξ_y = 0.59085228
   A = 0.18083668
   B = 0.12519247
   with pt = 0.00404182
    pc = 0.03194564
    pv = 0.06975884
    N = 808455.076
    b = 150.00
    " = 0.16731518
 ϕ_{y_comp} = 9.3780169E-006
with fc = 20.00
   Ec = 21019.039
   ξ_y = 0.71063323
   A = 0.0724275
   B = 0.0780059
   with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of   p -

From table 10-8:   p = 0.00039439
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 0.70288134
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises   f to steel strength
   All these variables have already been given in Shear control ratio calculation.
    NUD = 808455.076
    Ag = 67500.00
    f'cE = 20.00
    fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
   b = 150.00
   d = 257.00
    f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 5

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -1.9905E+008
Shear Force, Va = -40180.701
EDGE -B-
Bending Moment, Mb = -8.2820E+006
Shear Force, Vb = 40180.701
BOTH EDGES
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)

```
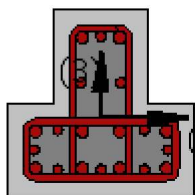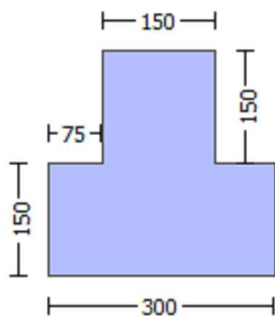          -Tension: Asl,ten = 1231.504
       -Compression: Asl,com = 1231.504
            -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60
---------------------------------------------------------------
---------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 111554.237
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 131240.279
   VCol = 179661.131
   knl = 0.73048788
       displacement_ductility_demand = 5.59349
---------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
       Mu = 8.2820E+006
       Vu = 40180.701
   d = 0.8*h = 240.00
   Nu = 808455.076
   Ag = 45000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
   where:
   Vs1 = 0.00 is calculated for section web, with:
      d = 120.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
   Vs1 is multiplied by   Col1 = 0.00
      s/d = 1.58333
   Vs2 = 66138.793 is calculated for section flange, with:
      d = 240.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
   Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 95659.751
      bw = 150.00
---------------------------------------------------------------


---------------------------------------------------------------
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END B -
 for rotation axis 3 and integ. section (b)
---------------------------------------------------------------
From analysis, chord rotation    = 0.01162323
  y = (My*Ls/3)/EIeff = 0.00207799 ((4.29),Biskinis Phd))
   My = 1.1609E+008
   Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 300.00
   From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.5865E+012
       factor = 0.70
         Ag = 67500.00
         fc' = 20.00
         N = 808455.076
      Ec*Ig = 7.9807E+012
---------------------------------------------------------------
---------------------------------------------------------------


Calculation of Yielding Moment My
---------------------------------------------------------------
```

Calculation of y and My according to Annex 7 -

----

y = Min(y_ten, y_com)
y_ten = 2.1133425E-005
with fy = 444.44
 d = 257.00
 y = 0.59085228
 A = 0.18083668
 B = 0.12519247
 with pt = 0.03194564
 pc = 0.03194564
 pv = 0.06975884
 N = 808455.076
 b = 150.00
 " = 0.16731518
y_comp = 9.3780169E-006
with fc = 20.00
 Ec = 21019.039
 y = 0.71063323
 A = 0.0724275
 B = 0.0780059
 with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 6

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
  Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
  Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  ν = 1.04891
    N = 808706.655
  fc = 20.00
    εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      we (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00

```
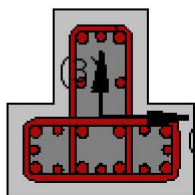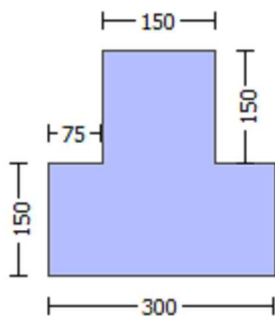      fywe = 555.55
      fce  = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.002
        c  = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
   yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
   2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
   v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
    2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
```

' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
u = cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
    co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.0035
 we (5.4c) = 0.00
  ase = Max((($A_{conf,max}$-AnoConf)/$A_{conf,max}$)*($A_{conf,min}$/$A_{conf,max}$),0) = 0.00
   The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
   of the rectangular sections confinement, which is expressed by (5.4d).
   The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
   "Theoretical Stress-Strain Model for Confined Concrete."
   J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
   Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
       is calculated as the area of core enclosed by the center lines of the perimeter hoops.
   Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
       is calculated by reducing all the dimensions of the area Aconf,max by a length
       equal to half the clear spacing between hoops.
   AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
   ----
   psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
     Lstir (Length of stirrups along Y) = 660.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 67500.00
   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
     Lstir (Length of stirrups along X) = 660.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 67500.00
   ----
     s = 190.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.002
     c = confinement factor = 1.00
 y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 yv = 0.00231479

shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
  2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
  v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
*cu (4.10) = 0.41100707

MRo (4.17) = 2.4385E+008
--->
  φu = φcu (4.2) = 2.1436548E-005
Mu = MRo

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 = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  ν = 1.04891
   N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
      of the rectangular sections confinement, which is expressed by (5.4d).
      The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
      "Theoretical Stress-Strain Model for Confined Concrete."
      J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
      Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
        is calculated as the area of core enclosed by the center lines of the perimeter hoops.
      Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
        is calculated by reducing all the dimensions of the area Aconf,max by a length
        equal to half the clear spacing between hoops.
      AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
    ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
   Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

     ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along Y) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00

     ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along X) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
     ----
      s = 190.00
     fywe = 555.55
     fce = 20.00
    From ((5.A5), TBDY), TBDY: εcc = 0.002
     αc = confinement factor = 1.00
  εy1 = 0.00231479
  εsh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55

su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
  2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
  v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
 b = 90.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
  2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
  v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)

--->
ν < εs,y1 - LHS eq.(4.7) is not satisfied
--->
ν < νc,y1 - RHS eq.(4.6) is not satisfied
--->
 φcu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω1, ω2, ν normalised to bo*do, instead of b*d
  - ε - parameters of confined concrete, fcc, εcc, used in lieu of fc, εcu
--->
Subcase: Rupture of tension steel
--->
ν* < ν*s,y2 - LHS eq.(4.5) is not satisfied
--->
ν* < ν*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
ν* < ν*c,y2 - LHS eq.(4.6) is not satisfied
--->
ν* < ν*c,y1 - RHS eq.(4.6) is satisfied
--->
 φ*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 φu = φcu (unconfined full section) = 1.7570028E-005
Mu = MRc

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 = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
 b = 300.00
 d = 257.00
 d' = 43.00
 ν = 0.52445308
   N = 808706.655
 fc = 20.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."

Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
is calculated as the area of core enclosed by the center lines of the perimeter hoops.

Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.

AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00404182

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

----

psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----

s = 190.00
fywe = 555.55
fce = 20.00

From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00

y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00

y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00

yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
  2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
  v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 538989.858
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 535.426
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00

Vs1 is multiplied by   Col1 = 0.83333333
      s/d = 0.79166667
   Vs2 = 0.00 is calculated for section flange, with:
      d = 120.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs2 is multiplied by   Col2 = 0.00
      s/d = 1.58333
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf < = 106950.853
      bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00

-Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
  Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
  Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.0035
        we (5.4c) = 0.00
        αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
           The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
           of the rectangular sections confinement, which is expressed by (5.4d).
           The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
           "Theoretical Stress-Strain Model for Confined Concrete."
           J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
           Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                   is calculated as the area of core enclosed by the center lines of the perimeter hoops.
           Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                   is calculated by reducing all the dimensions of the area Aconf,max by a length
                   equal to half the clear spacing between hoops.
           AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182

Lstir (Length of stirrups along X) = 660.00
                Astir (stirrups area) = 78.53982
                Asec (section area) = 67500.00

        ----
                s = 190.00
            fywe = 555.55
            fce = 20.00
        From ((5.A5), TBDY), TBDY: cc = 0.002
                c = confinement factor = 1.00
    y1 = 0.00231479
    sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
    su1 = 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
            su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
        From table 5A.1, TBDY: esu1_nominal = 0.08,
        For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
        characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
            y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
            with fs1 = fs = 555.55
            with Es1 = Es = 200000.00
    y2 = 0.00231479
    sh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55
    su2 = 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
            su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
        From table 5A.1, TBDY: esu2_nominal = 0.08,
        For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
        characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
            y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
            with fs2 = fs = 555.55
            with Es2 = Es = 200000.00
    yv = 0.00231479
    shv = 0.008
  ftv = 666.66
  fyv = 555.55
    suv = 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
            suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
        From table 5A.1, TBDY: esuv_nominal = 0.08,
        considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
        For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
        characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
            y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
            with fsv = fs = 555.55
            with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
    2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
    v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002

```
       c  = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,  1,  2,  v normalised to bo*do, instead of b*d
  -  -  parameters of confined concrete, fcc,  cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) =  2.0683116E-005
Mu = MRc
-------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----------------------------------------------------------------------
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
```

v = 1.04891
   N = 808706.655
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
    we (5.4c) = 0.00
    ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
      of the rectangular sections confinement, which is expressed by (5.4d).
      The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
      "Theoretical Stress-Strain Model for Confined Concrete."
      J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
      Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
         is calculated as the area of core enclosed by the center lines of the perimeter hoops.
      Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
         is calculated by reducing all the dimensions of the area Aconf,max by a length
         equal to half the clear spacing between hoops.
      AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00404182
  Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

    ----
    psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along Y) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along X) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
     s = 190.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.002
    c = confinement factor = 1.00
 y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 γv = 0.00231479
 εhv = 0.008
ftv = 666.66
fyv = 555.55
 εuv = 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
    εuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and γv, εhv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  ω2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  ωv = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
 b = 90.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
  εcc (5A.5, TBDY) = 0.002
    αc = confinement factor = 1.00
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
  ω2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
  ωv = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
ω < ωs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
ω < ωs,y1 - LHS eq.(4.7) is not satisfied
--->
ω < ωc,y1 - RHS eq.(4.6) is not satisfied
--->
 φcu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω1, ω2, ωv normalised to bo*do, instead of b*d
  - ε - parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
ω* < ω*s,y2 - LHS eq.(4.5) is not satisfied
--->
ω* < ω*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
        fywe = 555.55
        fce = 20.00

From ((5.A5), TBDY), TBDY: cc = 0.002
  c = confinement factor = 1.00
 y1 = 0.00231479
 sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
 su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
 su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
 ftv = 666.66
 fyv = 555.55
 suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
 2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
 v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
 b = 90.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
 cc (5A.5, TBDY) = 0.002
  c = confinement factor = 1.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
 2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
 v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->

v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
     N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035

we (5.4c) = 0.00
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
            The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
            of the rectangular sections confinement, which is expressed by (5.4d).
            The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
            "Theoretical Stress-Strain Model for Confined Concrete."
            J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
            Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                    is calculated as the area of core enclosed by the center lines of the perimeter hoops.
            Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                    is calculated by reducing all the dimensions of the area Aconf,max by a length
                    equal to half the clear spacing between hoops.
            AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        ----
            s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5.A5), TBDY): cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66

fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
    2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
    v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc

```
--->
  u =   cu (unconfined full section) =  2.0683116E-005
Mu = MRc
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077
---------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 786.7782
     Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00
-------------------------------------------------------------

---------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 1.10406
     Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
```

From (11.5.4.8), ACI 318-14: $Vs = Vs_1 + Vs_2 = 73486.813$
  where:
  $Vs_1 = 0.00$ is calculated for section web, with:
    $d = 120.00$
    $Av = 157079.633$
    $fy = 444.44$
    $s = 190.00$
  Vs_1 is multiplied by $Col_1 = 0.00$
    $s/d = 1.58333$
  $Vs_2 = 73486.813$ is calculated for section flange, with:
    $d = 240.00$
    $Av = 157079.633$
    $fy = 444.44$
    $s = 190.00$
  Vs_2 is multiplied by $Col_2 = 0.83333333$
    $s/d = 0.79166667$
  Vf ((11-3)-(11.4), ACI 440) $= 0.00$
  From (11-11), ACI 440: $Vs + Vf <= 106950.853$
    $bw = 150.00$

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor, $= 0.85$
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, $fc = fcm = 20.00$
Existing material of Secondary Member: Steel Strength, $fs = fsm = 444.44$
Concrete Elasticity, $Ec = 21019.039$
Steel Elasticity, $Es = 200000.00$
Max Height, $Hmax = 300.00$
Min Height, $Hmin = 150.00$
Max Width, $Wmax = 300.00$
Min Width, $Wmin = 150.00$
Eccentricity, $Ecc = 75.00$
Cover Thickness, $c = 25.00$
Element Length, $L = 3000.00$
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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, $M = 497313.962$
Shear Force, $V2 = 40180.701$
Shear Force, $V3 = 407.0034$
Axial Force, $F = -808455.076$
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: $Aslt = 0.00$
   -Compression: $Aslc = 5152.212$

Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.00514887
 θu = θy + θp = 0.00605749

 - Calculation of θy -

 θy = (My*Ls/3)/Eleff = 0.00605749 ((4.29),Biskinis Phd))
  My = 1.0155E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1221.891
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 6.8279E+012
     factor = 0.70
       Ag = 67500.00
       fc' = 20.00
       N = 808455.076
     Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

 θy = Min(θy_ten, θy_com)
 θy_ten = 2.4967781E-005
with fy = 444.44
    d = 257.00
     ξy = 0.65368599
    A = 0.18083668
    B = 0.14066427
     with pt = 0.00404182
        pc = 0.02151441
        pv = 0.05346005
        N = 808455.076
        b = 150.00
        " = 0.16731518
  θy_comp = 8.2060458E-006
with fc = 20.00
    Ec = 21019.039
     ξy = 0.81212445
    A = 0.0724275
    B = 0.09347771
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θp -

From table 10-8: θp = 0.00
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 1.21438
  d = 257.00
  s = 150.00
    ρt = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182

Av = 78.53982, is the area of every stirrup
Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
where f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
All these variables have already been given in Shear control ratio calculation.
  NUD = 808455.076
  Ag = 67500.00
  f'cE = 20.00
  fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
  b = 150.00
  d = 257.00
  f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 7

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85

Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -2.2670E+006
Shear Force, Va = -407.0034
EDGE -B-
Bending Moment, Mb = 497313.962
Shear Force, Vb = 407.0034
BOTH EDGES
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
      -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
      -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104464.968
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122899.962
   VCol = 122899.962
   knl = 1.00
      displacement_ductility_demand = 0.0048952

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
   fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 497313.962
      Vu = 407.0034
   d = 0.8*h = 240.00

Nu = 808455.076
    Ag = 45000.00
    From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
    where:
    Vs1 = 66138.793 is calculated for section web, with:
      d = 240.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
    Vs1 is multiplied by   Col1 = 0.83333333
      s/d = 0.79166667
    Vs2 = 0.00 is calculated for section flange, with:
      d = 120.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
    Vs2 is multiplied by   Col2 = 0.00
      s/d = 1.58333
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf < = 95659.751
      bw = 150.00

----
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END B -
 for rotation axis 2 and integ. section (b)

From analysis, chord rotation   = 2.9652621E-005
 y = (My*Ls/3)/EIeff = 0.00605749 ((4.29),Biskinis Phd))
  My = 1.0155E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1221.891
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 6.8279E+012
      factor = 0.70
        Ag = 67500.00
        fc' = 20.00
        N = 808455.076
    Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of   y and My according to Annex 7   -
----
  y = Min(y_ten, y_com)
  y_ten = 2.4967781E-005
with fy = 444.44
    d = 257.00
     y = 0.65368599
    A = 0.18083668
    B = 0.14066427
     with pt = 0.05867566
         pc = 0.02151441
         pv = 0.05346005
         N = 808455.076
         b = 150.00
          " = 0.16731518
  y_comp = 8.2060458E-006
with fc = 20.00
    Ec = 21019.039
     y = 0.81212445
    A = 0.0724275
    B = 0.09347771
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 8

column C1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##

Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
   Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
   Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
     N = 808706.655

fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
             is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
             is calculated by reducing all the dimensions of the area Aconf,max by a length
             equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along X) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
           s = 190.00
          fywe = 555.55
          fce = 20.00
     From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.

with fs2 = fs = 555.55
        with Es2 = Es = 200000.00
    yv = 0.00231479
   shv = 0.008
  ftv = 666.66
  fyv = 555.55
   suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
    2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
    v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
    2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->

v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
          s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00

y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 555.55
   with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
b = 240.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
  c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->

Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
   N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization

of the rectangular sections confinement, which is expressed by (5.4d).
The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
"Theoretical Stress-Strain Model for Confined Concrete."
J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
    is calculated as the area of core enclosed by the center lines of the perimeter hoops.
Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
    is calculated by reducing all the dimensions of the area Aconf,max by a length
    equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

----

psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
   Lstir (Length of stirrups along Y) = 660.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 67500.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
   Lstir (Length of stirrups along X) = 660.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 67500.00

----

s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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

    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

   From table 5A.1, TBDY: esuv_nominal = 0.08,

   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY

   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered

   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.

    with fsv = fs = 555.55

    with Esv = Es = 200000.00

   1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986

   2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649

   v = Asl,mid/(b*d)*(fsv/fc) = 1.48499

and confined core properties:

  b = 90.00

  d = 227.00

  d' = 13.00

  fcc (5A.2, TBDY) = 20.00

   cc (5A.5, TBDY) = 0.002

      c = confinement factor = 1.00

   1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544

   2 = Asl,com/(b*d)*(fs2/fc) = 1.12766

   v = Asl,mid/(b*d)*(fsv/fc) = 2.80207

Case/Assumption: Unconfinesd full section - Steel rupture

 ' does not satisfy Eq. (4.3)

--->

v < vs,c - RHS eq.(4.5) is not satisfied

--->

Case/Assumption Rejected.

--->

New Case/Assumption: Unconfinesd full section - Spalling of concrete cover

 ' satisfies Eq. (4.4)

--->

v <   s,y1 - LHS eq.(4.7) is not satisfied

--->

v < vc,y1 - RHS eq.(4.6) is not satisfied

--->

 cu (4.11) = 0.77510846

MRc (4.18) = 1.6233E+008

--->

New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover

In expressions below, the following modifications have been made

   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o

   - N, 1, 2, v normalised to bo*do, instead of b*d

   - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu

--->

Subcase: Rupture of tension steel

--->

v* < v*s,y2 - LHS eq.(4.5) is not satisfied

--->

v* < v*s,c - LHS eq.(4.5) is not satisfied

--->

Subcase rejected

--->

New Subcase: Failure of compression zone

--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied

--->

v* < v*c,y1 - RHS eq.(4.6) is satisfied

--->

 *cu (4.10) = 0.8328476

MRo (4.17) = 9.9542E+007

MRo < 0.8*MRc

--->

 u =   cu (unconfined full section) = 1.7570028E-005

Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008

----

with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
    co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
       we (5.4c) = 0.00
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
       ----
       psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
       ----
       psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
       ----
          s = 190.00
          fywe = 555.55
          fce = 20.00
       From ((5.A5), TBDY), TBDY: cc = 0.002
          c = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
   su1 = 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
          su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
        From table 5A.1, TBDY: esu1_nominal = 0.08,
        For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
        characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
          y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
          with fs1 = fs = 555.55
          with Es1 = Es = 200000.00
     y2 = 0.00231479
     sh2 = 0.008
   ft2 = 666.66
   fy2 = 555.55
     su2 = 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
         su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
         y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs2 = fs = 555.55
         with Es2 = Es = 200000.00
     yv = 0.00231479
     shv = 0.008
   ftv = 666.66
   fyv = 555.55
     suv = 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
         suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
         y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fsv = fs = 555.55
         with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
     2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
     v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
   b = 240.00
   d = 227.00
   d' = 13.00
   fcc (5A.2, TBDY) = 20.00
     cc (5A.5, TBDY) = 0.002
       c = confinement factor = 1.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
     2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
     v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied

```
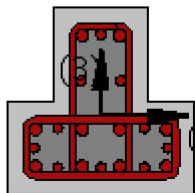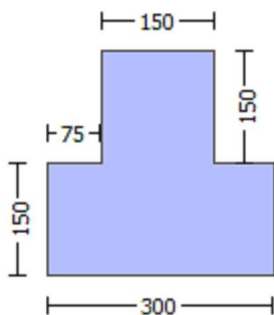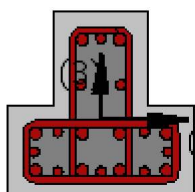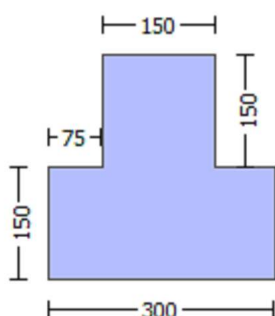--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,  1,  2,  v normalised to bo*do, instead of b*d
  -  -  parameters of confined concrete, fcc,  cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u =  cu (4.2) = 2.1436548E-005
Mu = MRo
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 538989.858
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by  Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
```

Av = 157079.633
  fy = 444.44
  s = 190.00
 Vs2 is multiplied by   Col2 = 0.00
   s/d = 1.58333
 Vf ((11-3)-(11.4), ACI 440) = 0.00
 From (11-11), ACI 440: Vs + Vf <= 106950.853
   bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
   Mu = 535.426
   Vu = 1.7373234E-005
 d = 0.8*h = 240.00
 Nu = 808706.655
 Ag = 45000.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
 where:
 Vs1 = 73486.813 is calculated for section web, with:
   d = 240.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
 Vs1 is multiplied by   Col1 = 0.83333333
   s/d = 0.79166667
 Vs2 = 0.00 is calculated for section flange, with:
   d = 120.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
 Vs2 is multiplied by   Col2 = 0.00
   s/d = 1.58333
 Vf ((11-3)-(11.4), ACI 440) = 0.00
 From (11-11), ACI 440: Vs + Vf <= 106950.853
   bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00

```
################################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
################################################################
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
   -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 1231.504
   -Compression: Asl,com = 1231.504
      -Middle: Asl,mid = 2689.203
------------------------------------------------------------
------------------------------------------------------------


Calculation of Shear Capacity ratio , Ve/Vr  =  0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 =  Max(Mu1+ , Mu1-) = 2.0480E+008
   Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
   Mu2+ = 2.0480E+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- = 2.0480E+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


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

----------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----------------------------------------------------------------
with full section properties:
```

b = 150.00
d = 257.00
d' = 43.00
v = 1.04891
    N = 808706.655
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
        we (5.4c) = 0.00
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
            The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
            of the rectangular sections confinement, which is expressed by (5.4d).
            The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
            "Theoretical Stress-Strain Model for Confined Concrete."
            J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
            Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                    is calculated as the area of core enclosed by the center lines of the perimeter hoops.
            Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                    is calculated by reducing all the dimensions of the area Aconf,max by a length
                    equal to half the clear spacing between hoops.
            AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        ----
            s = 190.00
          fywe = 555.55
          fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
  su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 555.55
        with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
  su2 = 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

$su2 = 0.4*esu2\_nominal ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esu2\_nominal = 0.08$,
For calculation of $esu2\_nominal$ and $y2$, $sh2,ft2,fy2$, it is considered
characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.
$y1$, $sh1,ft1,fy1$, are also multiplied by $Min(1,1.25*(lb/ld)^2/3)$, from 10.3.5, ASCE 41-17.
with $fs2 = fs = 555.55$
with $Es2 = Es = 200000.00$
$yv = 0.00231479$
$shv = 0.008$
$ftv = 666.66$
$fyv = 555.55$
$suv = 0.032$
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
$lo/lou,min = lb/ld = 1.00$
$suv = 0.4*esuv\_nominal ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esuv\_nominal = 0.08$,
considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
For calculation of $esuv\_nominal$ and yv, shv,ftv,fyv, it is considered
characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
$y1$, $sh1,ft1,fy1$, are also multiplied by $Min(1,1.25*(lb/ld)^2/3)$, from 10.3.5, ASCE 41-17.
with $fsv = fs = 555.55$
with $Esv = Es = 200000.00$
$1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994$
$2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994$
$v = Asl,mid/(b*d)*(fsv/fc) = 1.93773$
and confined core properties:
$b = 90.00$
$d = 227.00$
$d' = 13.00$
$fcc (5A.2, TBDY) = 20.00$
$cc (5A.5, TBDY) = 0.002$
c = confinement factor = 1.00
$1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441$
$2 = Asl,com/(b*d)*(fs2/fc) = 1.67441$
$v = Asl,mid/(b*d)*(fsv/fc) = 3.65636$
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
$v < vs,c$ - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
' satisfies Eq. (4.4)
--->
$v < s,y1$ - LHS eq.(4.7) is not satisfied
--->
$v < vc,y1$ - RHS eq.(4.6) is not satisfied
--->
$cu (4.11) = 0.65844416$
$MRc (4.18) = 2.0480E+008$
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
$v* < v*s,y2$ - LHS eq.(4.5) is not satisfied
--->
$v* < v*s,c$ - LHS eq.(4.5) is not satisfied
--->
Subcase rejected

--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
 fc = 20.00
  co (5A.5, TBDY) = 0.002
 Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00

```
        s = 190.00
      fywe = 555.55
       fce = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.002
        c = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 555.55
       with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 555.55
       with Es2 = Es = 200000.00
   yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 555.55
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
 and confined core properties:
   b = 90.00
   d = 227.00
   d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5.A.5, TBDY) = 0.002
       c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
```

Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                 is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                 is calculated by reducing all the dimensions of the area Aconf,max by a length
                 equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
         ----
         psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
         ----
         psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
         ----
         s = 190.00
        fywe = 555.55
        fce = 20.00
     From ((5.A5), TBDY), TBDY: cc = 0.002
         c = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 555.55
       with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 555.55
       with Es2 = Es = 200000.00

yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
  2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
  v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->

```
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) =  2.0683116E-005
Mu = MRc
-----------------------------------------------------------

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

--------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
 u = 2.0683116E-005
Mu = 2.0480E+008
--------------------------------------------------------------------
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                  is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                  is calculated by reducing all the dimensions of the area Aconf,max by a length
                  equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      -----------------------------------------------------------------
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      -----------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      -----------------------------------------------------------------
          s = 190.00
        fywe = 555.55
        fce  = 20.00
      From ((5.A5), TBDY), TBDY:  cc = 0.002
          c  = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
```

ft1 = 666.66
fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
ftv = 666.66
fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
    2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
    v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->

New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 786.7782
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00

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```
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs1 is multiplied by   Col1 = 0.00
      s/d = 1.58333
   Vs2 = 73486.813 is calculated for section flange, with:
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 106950.853
      bw = 150.00
------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 194244.077
   knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
      = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1.10406
      Vu = 9.8273208E-008
   d = 0.8*h = 240.00
   Nu = 808706.655
   Ag = 45000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
   where:
   Vs1 = 0.00 is calculated for section web, with:
      d = 120.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs1 is multiplied by   Col1 = 0.00
      s/d = 1.58333
   Vs2 = 73486.813 is calculated for section flange, with:
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 106950.853
      bw = 150.00
------------------------------------------------------------
------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rctcs

Constant Properties
------------------------------------------------------------
```

Knowledge Factor, = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -8.2820E+006
Shear Force, V2 = 40180.701
Shear Force, V3 = 407.0034
Axial Force, F = -808455.076
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 1231.504
    -Compression: Asl,com = 1231.504
       -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = * u = 0.00210153
  u = y + p = 0.00247238

 - Calculation of y -
----
 y = (My*Ls/3)/Eleff = 0.00207799 ((4.29),Biskinis Phd))
  My = 1.1609E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 300.00
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.5865E+012
    factor = 0.70
      Ag = 67500.00
      fc' = 20.00
      N = 808455.076
    Ec*Ig = 7.9807E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 2.1133425E-005
 with fy = 444.44

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```
      d = 257.00
      y = 0.59085228
      A = 0.18083668
      B = 0.12519247
     with pt = 0.00404182
        pc = 0.03194564
        pv = 0.06975884
        N = 808455.076
        b = 150.00
        " = 0.16731518
   y_comp = 9.3780169E-006
 with fc = 20.00
     Ec = 21019.039
      y = 0.71063323
      A = 0.0724275
      B = 0.0780059
      with Es = 200000.00
```

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-8: p = 0.00039439
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 0.70288134
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
   All these variables have already been given in Shear control ratio calculation.
    NUD = 808455.076
    Ag = 67500.00
    f'cE = 20.00
    fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
   b = 150.00
   d = 257.00
    f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -2.6772E+008
Shear Force, Va = -48255.683
EDGE -B-
Bending Moment, Mb = -1.0196E+007
Shear Force, Vb = 48255.683
BOTH EDGES
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 2375.044
   -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 1231.504
   -Compression: Asl,com = 1231.504
       -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104483.818
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122922.139
   VCol = 122922.139
   knl = 1.00
      displacement_ductility_demand = 1.42915

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 2.6772E+008
     Vu = 48255.683
  d = 0.8*h = 240.00
  Nu = 809157.043
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 66138.793 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 95659.751
    bw = 150.00

----
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END A -
 for rotation axis 3 and integ. section (a)

From analysis, chord rotation   = 0.05491011
  y = (My*Ls/3)/Eleff = 0.03842148 ((4.29),Biskinis Phd))

My = 1.1607E+008
Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 5547.923
From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.5865E+012
   factor = 0.70
     Ag = 67500.00
     fc' = 20.00
     N = 809157.043
   Ec*Ig = 7.9807E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
 y = Min(y_ten, y_com)
 y_ten = 2.1136989E-005
with fy = 444.44
   d = 257.00
   y = 0.59092127
   A = 0.18087765
   B = 0.12523344
   with pt = 0.03194564
     pc = 0.03194564
     pv = 0.06975884
     N = 809157.043
     b = 150.00
      " = 0.16731518
 y_comp = 9.3746285E-006
with fc = 20.00
   Ec = 21019.039
   y = 0.71089008
   A = 0.07237434
   B = 0.0780059
   with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 10

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
       -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
   Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
   Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
   b = 150.00
   d = 257.00
   d' = 43.00
   ν = 1.04891
      N = 808706.655
   fc = 20.00
    εco (5A.5, TBDY) = 0.002
   Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: εcu = 0.0035
        ωwe (5.4c) = 0.00
        αase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
           The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
           of the rectangular sections confinement, which is expressed by (5.4d).
           The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
           "Theoretical Stress-Strain Model for Confined Concrete."
           J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
           Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                   is calculated as the area of core enclosed by the center lines of the perimeter hoops.
           Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                   is calculated by reducing all the dimensions of the area Aconf,max by a length
                   equal to half the clear spacing between hoops.
           AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
        ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
      Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without

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earthquake detailing (90° closed stirrups)

```
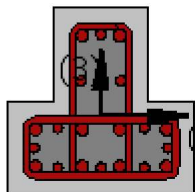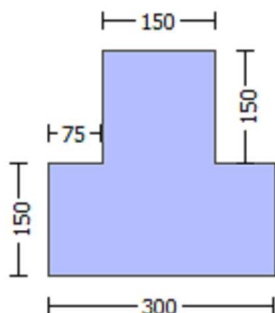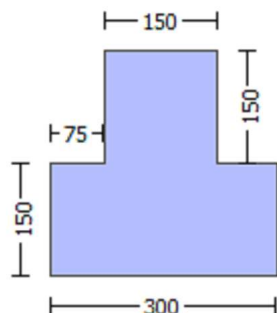        -------------------------------------------------------------------
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        -------------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
        -------------------------------------------------------------------
            s = 190.00
          fywe = 555.55
          fce  = 20.00
      From ((5.A5), TBDY), TBDY:  cc = 0.002
            c = confinement factor = 1.00
    y1 = 0.00231479
   sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
   su1 = 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
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 555.55
        with Es1 = Es = 200000.00
    y2 = 0.00231479
   sh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55
   su2 = 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
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 555.55
        with Es2 = Es = 200000.00
    yv = 0.00231479
   shv = 0.008
  ftv = 666.66
  fyv = 555.55
   suv = 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
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 555.55
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
```

```
      2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
      v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
   b = 90.00
   d = 227.00
   d' = 13.00
   fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c  = confinement factor = 1.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
     2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
     v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N,   1,   2,   v normalised to bo*do, instead of b*d
   -   -  parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
  *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) =  1.7570028E-005
Mu = MRc
------------------------------------------------------------

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 = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
       αse = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
        ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

        ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00

        ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
          s = 190.00
        fywe = 555.55
        fce = 20.00
      From ((5.A5), TBDY), TBDY: εcc = 0.002
          αc = confinement factor = 1.00
    εy1 = 0.00231479
   εsh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
   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 = 555.55
      with Es1 = Es = 200000.00
   εy2 = 0.00231479
  εsh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55

su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
b = 240.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
  c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1, 2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->

v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182

Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00

       ----
            s = 190.00
         fywe = 555.55
          fce = 20.00
     From ((5.A5), TBDY): cc = 0.002
          c = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
   su1 = 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
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 555.55
       with Es1 = Es = 200000.00
   y2 = 0.00231479
   sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
   su2 = 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
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 555.55
       with Es2 = Es = 200000.00
   yv = 0.00231479
   shv = 0.008
 ftv = 666.66
 fyv = 555.55
   suv = 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
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 555.55
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
   2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
   v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
   b = 90.00
   d = 227.00
   d' = 13.00
   fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002

```
    c  = confinement factor = 1.00
    ρ1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
    ρ2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    ρv = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
ρv < ρvs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
ρv < ρs,y1 - LHS eq.(4.7) is not satisfied
--->
ρv < ρvc,y1 - RHS eq.(4.6) is not satisfied
--->
 φcu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ρ1, ρ2, ρv normalised to bo*do, instead of b*d
  - ε - parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
ρv* < ρ*s,y2 - LHS eq.(4.5) is not satisfied
--->
ρv* < ρ*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
ρv* < ρ*c,y2 - LHS eq.(4.6) is not satisfied
--->
ρv* < ρ*c,y1 - RHS eq.(4.6) is satisfied
--->
 φ*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 φu = φcu (unconfined full section) = 1.7570028E-005
Mu = MRc
-------------------------------------------------------------

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 = 2.1436548E-005
Mu = 2.4385E+008
----------------------------------------------------------------------
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
```

v = 0.52445308
  N = 808706.655
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.0035
    we (5.4c) = 0.00
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00404182
  Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
  y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fs2 = fs = 555.55
 with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esuv_nominal = 0.08,
 considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
 For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fsv = fs = 555.55
 with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
 2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
 v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
 b = 240.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
 cc (5A.5, TBDY) = 0.002
 c = confinement factor = 1.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
 2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
 v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1, 2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 538989.858
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 535.426
   Vu = 1.7373234E-005
d = 0.8*h = 240.00
Nu = 808706.655
Ag = 45000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
where:
Vs1 = 73486.813 is calculated for section web, with:
  d = 240.00
  Av = 157079.633
  fy = 444.44
  s = 190.00
Vs1 is multiplied by   Col1 = 0.83333333
  s/d = 0.79166667
Vs2 = 0.00 is calculated for section flange, with:
  d = 120.00
  Av = 157079.633
  fy = 444.44
  s = 190.00
Vs2 is multiplied by   Col2 = 0.00
  s/d = 1.58333
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 106950.853
  bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
  Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
  Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
        we (5.4c) = 0.00
       ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and

is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
----
psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered

characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
　y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
　with fsv = fs = 555.55
　with Esv = Es = 200000.00
　1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
　2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
　v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
　b = 90.00
　d = 227.00
　d' = 13.00
　fcc (5A.2, TBDY) = 20.00
　　cc (5A.5, TBDY) = 0.002
　　　c = confinement factor = 1.00
　1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
　2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
　v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
　' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
　' satisfies Eq. (4.4)
--->
v <　s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
　cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
　- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
　- N, 　1, 　2, 　v normalised to bo*do, instead of b*d
　- 　- 　parameters of confined concrete, fcc, 　cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
　*cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
　u = 　cu (unconfined full section) = 2.0683116E-005
Mu = MRc

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 = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  ν = 1.04891
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00

      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
      fywe = 555.55
      fce = 20.00
    From ((5A.5), TBDY), TBDY: εcc = 0.002
        αc = confinement factor = 1.00
  εy1 = 0.00231479
  εsh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
  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, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     εy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55

with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
fy2 = 555.55
  su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 555.55
    with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
fyv = 555.55
  suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o

- N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

```
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
      ----------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
      ----------------------------------------------------------------
            s = 190.00
          fywe = 555.55
          fce = 20.00
      From ((5.A5), TBDY), TBDY:  cc = 0.002
            c = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
   yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
```

and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005

Mu = 2.0480E+008

----

with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
             is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
             is calculated by reducing all the dimensions of the area Aconf,max by a length
             equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
       fywe = 555.55
       fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 555.55
    with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1, 2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->

v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 786.7782
     Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
     d = 120.00
     Av = 157079.633
     fy = 444.44
     s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
     s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
     d = 240.00
     Av = 157079.633
     fy = 444.44
     s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
     s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
     bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077

knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

λ = 1 (normal-weight concrete)
$fc' = 20.00$, but $fc^{0.5} <= 8.3$ MPa (22.5.3.1, ACI 318-14)
$M/Vd = 2.00$
   Mu = 1.10406
   Vu = 9.8273208E-008
$d = 0.8*h = 240.00$
Nu = 808706.655
Ag = 45000.00
From (11.5.4.8), ACI 318-14: $Vs = Vs1 + Vs2 = 73486.813$
where:
$Vs1 = 0.00$ is calculated for section web, with:
   d = 120.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs1 is multiplied by Col1 = 0.00
   s/d = 1.58333
$Vs2 = 73486.813$ is calculated for section flange, with:
   d = 240.00
   Av = 157079.633
   fy = 444.44
   s = 190.00
Vs2 is multiplied by Col2 = 0.83333333
   s/d = 0.79166667
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: $Vs + Vf <= 106950.853$
   bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor, κ = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, $fc = fcm = 20.00$
Existing material of Secondary Member: Steel Strength, $fs = fsm = 444.44$
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -5.9160E+006
Shear Force, V2 = -48255.683
Shear Force, V3 = -899.0326
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 2375.044
  -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 2261.947
  -Compression: Asl,com = 829.3805
    -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = *\theta u = 0.04789747$
$\theta u = \theta y + \theta p = 0.05634997$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.04834756$ ((4.29),Biskinis Phd))
 My = 1.6506E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 6000.00
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 6.8279E+012
   factor = 0.70
     Ag = 67500.00
     fc' = 20.00
     N = 809157.043
   Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of ϕy and My according to Annex 7 -

Assuming neutral axis out of flange ($\xi y > t/d$, compression zone NOT rectangular)
extended expressions (2.1)-(2.7) of Biskinis-Fardis (2009) are adopted with:
flange width, b = 300.00
web width, bw = 150.00
flange thickness, t = 150.00

 $\phi y = Min(\phi y\_ten, \phi y\_com)$
 $\phi y\_ten = 2.0659202E-005$
 with fy = 444.44
   d = 257.00
    $\xi y = 0.58146047$
   A = 0.24221726
   B = 0.15860591
    with pt = 0.00404182
      pc = 0.0107572
      pv = 0.02673002
      N = 809157.043
      b = 300.00
       " = 0.16731518
 $\phi y\_comp = 1.0079620E-005$
 with fc = 20.00
   Ec = 21019.039
    $\xi y = 0.66116882$

A = 0.13371395
    B = 0.11137837
     with Es = 200000.00
CONFIRMATION: y = 0.66116882 > t/d

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-8: p = 0.00800241
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 1.21438
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
   All these variables have already been given in Shear control ratio calculation.
    NUD = 809157.043
    Ag = 67500.00
    f'cE = 20.00
    fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.06682506
   b = 300.00
   d = 257.00
    f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 11

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
###
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -5.9160E+006
Shear Force, Va = -899.0326
EDGE -B-
Bending Moment, Mb = 1.0991E+006
Shear Force, Vb = 899.0326
BOTH EDGES
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 2375.044
    -Compression: Aslc = 2777.168
Longitudinal Reinforcement Area Distribution (in 3 divisions)

```
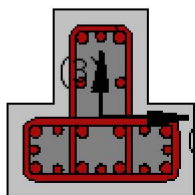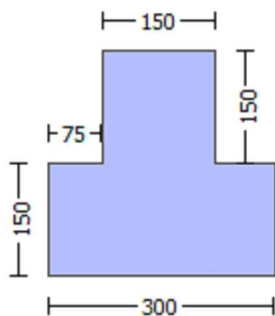        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
          -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778
-------------------------------------------------------------
-------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104483.818
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122922.139
  VCol = 122922.139
  knl = 1.00
     displacement_ductility_demand = 0.06412255
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 5.9160E+006
     Vu = 899.0326
  d = 0.8*h = 240.00
  Nu = 809157.043
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
  where:
  Vs1 = 66138.793 is calculated for section web, with:
     d = 240.00
     Av = 157079.633
     fy = 400.00
     s = 190.00
  Vs1 is multiplied by   Col1 = 0.83333333
     s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
     d = 120.00
     Av = 157079.633
     fy = 400.00
     s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
     s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 95659.751
     bw = 150.00
-------------------------------------------------------------


-------------------------------------------------------------
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END A -
 for rotation axis 2 and integ. section (a)
-------------------------------------------------------------
From analysis, chord rotation    = 0.00310017
  y = (My*Ls/3)/Eleff = 0.04834756 ((4.29),Biskinis Phd))
  My = 1.6506E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 6000.00
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 6.8279E+012
     factor = 0.70
        Ag = 67500.00
        fc' = 20.00
        N = 809157.043
     Ec*Ig = 9.7541E+012
-------------------------------------------------------------
-------------------------------------------------------------


Calculation of Yielding Moment My
-------------------------------------------------------------
```

Calculation of ψy and My according to Annex 7   -

Assuming neutral axis out of flange (ξy > t/d, compression zone NOT rectangular)
extended expressions (2.1)-(2.7) of Biskinis-Fardis (2009) are adopted with:
flange width, b = 300.00
web width, bw = 150.00
flange thickness, t = 150.00

  ξy = Min(ξy_ten, ξy_com)
  ξy_ten = 2.0659202E-005
 with fy = 444.44
     d = 257.00
      y = 0.58146047
     A = 0.24221726
     B = 0.15860591
     with pt = 0.02933783
        pc = 0.0107572
        pv = 0.02673002
        N = 809157.043
        b = 300.00
        " = 0.16731518
  ξy_comp = 1.0079620E-005
 with fc = 20.00
     Ec = 21019.039
      y = 0.66116882
     A = 0.13371395
     B = 0.11137837
      with Es = 200000.00
CONFIRMATION: y = 0.66116882 > t/d

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 12

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
  Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
  Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  ν = 1.04891
    N = 808706.655
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.0035
       ωwe (5.4c) = 0.00
       αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                  is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                  is calculated by reducing all the dimensions of the area Aconf,max by a length
                  equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
       ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
       ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
       ----
          s = 190.00

```
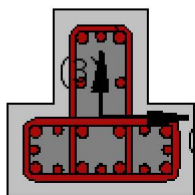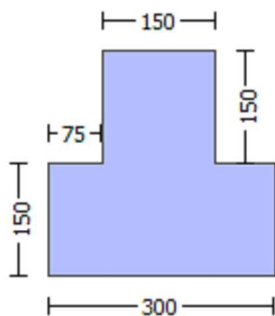      fywe = 555.55
       fce  = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.002
        c  = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
   y2 = 0.00231479
   sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
   yv = 0.00231479
   shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
   2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
   v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c  = confinement factor = 1.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
     2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
     v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
```

' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
    co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.0035
  we (5.4c) = 0.00
  ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
    The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
    of the rectangular sections confinement, which is expressed by (5.4d).
    The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
    "Theoretical Stress-Strain Model for Confined Concrete."
    J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
    Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
          is calculated as the area of core enclosed by the center lines of the perimeter hoops.
    Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
          is calculated by reducing all the dimensions of the area Aconf,max by a length
          equal to half the clear spacing between hoops.
    AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
    ----
    psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along Y) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along X) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
      s = 190.00
     fywe = 555.55
     fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479

shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
  2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
  v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707

MRo (4.17) = 2.4385E+008
--->
 u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                 is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                 is calculated by reducing all the dimensions of the area Aconf,max by a length
                 equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
       fywe = 555.55
       fce = 20.00
     From ((5.A5), TBDY), TBDY: cc = 0.002
         c = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55

su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
b = 90.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
  c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)

--->
v < εs,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
ξcu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ε1, ε2, v normalised to bo*do, instead of b*d
  - εc, εcu parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
ξ*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
φu = φcu (unconfined full section) = 1.7570028E-005
Mu = MRc

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 = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."

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Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
is calculated as the area of core enclosed by the center lines of the perimeter hoops.
Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

----

psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----

s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 133865.445
   knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 538989.858
      Vu = 1.7373234E-005
   d = 0.8*h = 240.00
   Nu = 808706.655
   Ag = 45000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
   where:
   Vs1 = 73486.813 is calculated for section web, with:
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs1 is multiplied by Col1 = 0.83333333
      s/d = 0.79166667
   Vs2 = 0.00 is calculated for section flange, with:
      d = 120.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
   Vs2 is multiplied by Col2 = 0.00
      s/d = 1.58333
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 106950.853
      bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 133865.445
   knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 535.426
      Vu = 1.7373234E-005
   d = 0.8*h = 240.00
   Nu = 808706.655
   Ag = 45000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
   where:
   Vs1 = 73486.813 is calculated for section web, with:
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00

Vs1 is multiplied by   Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00

-Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
   Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
   Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
        we (5.4c) = 0.00
        ase = Max((($(Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
           The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
           of the rectangular sections confinement, which is expressed by (5.4d).
           The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
           "Theoretical Stress-Strain Model for Confined Concrete."
           J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
           Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                   is calculated as the area of core enclosed by the center lines of the perimeter hoops.
           Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                   is calculated by reducing all the dimensions of the area Aconf,max by a length
                   equal to half the clear spacing between hoops.
           AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182

Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00

----

s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
$y1 = 0.00231479$
$sh1 = 0.008$
$ft1 = 666.66$
$fy1 = 555.55$
$su1 = 0.032$
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
$su1 = 0.4*esu1\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
$y2 = 0.00231479$
$sh2 = 0.008$
$ft2 = 666.66$
$fy2 = 555.55$
$su2 = 0.032$
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
$su2 = 0.4*esu2\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
$yv = 0.00231479$
$shv = 0.008$
$ftv = 666.66$
$fyv = 555.55$
$suv = 0.032$
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
$suv = 0.4*esuv\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 555.55
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
b = 90.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002

c = confinement factor = 1.00
    ω1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
    ω2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
    ωv = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
ωv < ωvs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
ωv < ωs,y1 - LHS eq.(4.7) is not satisfied
--->
ωv < ωvc,y1 - RHS eq.(4.6) is not satisfied
--->
 εcu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω1, ω2, ωv normalised to bo*do, instead of b*d
  - ε - parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
ωv* < ω*s,y2 - LHS eq.(4.5) is not satisfied
--->
ωv* < ω*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
ωv* < ω*c,y2 - LHS eq.(4.6) is not satisfied
--->
ωv* < ω*c,y1 - RHS eq.(4.6) is not satisfied
--->
 ε*cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 φu = φcu (unconfined full section) = 2.0683116E-005
Mu = MRc

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 = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
 b = 150.00
 d = 257.00
 d' = 43.00

v = 1.04891
   N = 808706.655
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
             is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
             is calculated by reducing all the dimensions of the area Aconf,max by a length
             equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

        ----
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along Y) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
           Lstir (Length of stirrups along X) = 660.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 67500.00
        ----
           s = 190.00
        fywe = 555.55
        fce = 20.00
     From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 555.55
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
b = 90.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.0035
       we (5.4c) = 0.00
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                 is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                 is calculated by reducing all the dimensions of the area Aconf,max by a length
                 equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00404182
     Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
     ----
       psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
     ----
       psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
     ----
          s = 190.00
          fywe = 555.55
          fce = 20.00

From ((5.A5), TBDY), TBDY: cc = 0.002
     c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->

v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
     N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035

we (5.4c) = 0.00
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
      of the rectangular sections confinement, which is expressed by (5.4d).
      The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
      "Theoretical Stress-Strain Model for Confined Concrete."
      J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
      Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
            is calculated as the area of core enclosed by the center lines of the perimeter hoops.
      Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
            is calculated by reducing all the dimensions of the area Aconf,max by a length
            equal to half the clear spacing between hoops.
      AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
       fywe = 555.55
       fce = 20.00
   From ((5.A5), TBDY: cc = 0.002
         c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66

fyv = 555.55
  suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1, 2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc

--->
   u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 194244.077
   knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 786.7782
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 194244.077
   knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 1.10406
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -2.6772E+008
Shear Force, V2 = -48255.683
Shear Force, V3 = -899.0326
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 2375.044
    -Compression: Aslc = 2777.168

Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 1231.504
   -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R}$ = $*$ θ_u = 0.0394603
 θ_u = θ_y + θ_p = 0.04642389

 - Calculation of θ_y -

 θ_y = (My*Ls/3)/Eleff = 0.03842148 ((4.29),Biskinis Phd))
 My = 1.1607E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 5547.923
 From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.5865E+012
    factor = 0.70
      Ag = 67500.00
      fc' = 20.00
      N = 809157.043
    Ec*Ig = 7.9807E+012

Calculation of Yielding Moment My

Calculation of ϕ_y and My according to Annex 7   -

 ϕ_y = Min(ϕ_{y_ten}, ϕ_{y_com})
 ϕ_{y_ten} = 2.1136989E-005
with fy = 444.44
    d = 257.00
    ξ_y = 0.59092127
    A = 0.18087765
    B = 0.12523344
    with pt = 0.00404182
       pc = 0.03194564
       pv = 0.06975884
       N = 809157.043
       b = 150.00
       " = 0.16731518
 ϕ_{y_comp} = 9.3746285E-006
with fc = 20.00
    Ec = 21019.039
    ξ_y = 0.71089008
    A = 0.07237434
    B = 0.0780059
    with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θ_p -

From table 10-8: θ_p = 0.00800241
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VColOE = 0.70288134
  d = 257.00
  s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182

Av = 78.53982, is the area of every stirrup
Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
All these variables have already been given in Shear control ratio calculation.
  NUD = 809157.043
  Ag = 67500.00
  f'cE = 20.00
  fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
  b = 150.00
  d = 257.00
  f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)

Calculation No. 13

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform + X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85

Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -2.6772E+008
Shear Force, Va = -48255.683
EDGE -B-
Bending Moment, Mb = -1.0196E+007
Shear Force, Vb = 48255.683
BOTH EDGES
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
      -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
      -Compression: Asl,com = 1231.504
         -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 106924.764
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 125793.84
   VCol = 179705.486
   knl = 0.70
      displacement_ductility_demand = 7.57014

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
   fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1.0196E+007
      Vu = 48255.683
   d = 0.8*h = 240.00

```
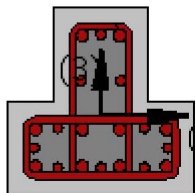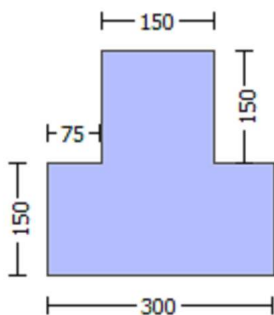   Nu = 809157.043
   Ag = 45000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
   where:
   Vs1 = 0.00 is calculated for section web, with:
      d = 120.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
   Vs1 is multiplied by   Col1 = 0.00
      s/d = 1.58333
   Vs2 = 66138.793 is calculated for section flange, with:
      d = 240.00
      Av = 157079.633
      fy = 400.00
      s = 190.00
   Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 95659.751
      bw = 150.00
-----------------------------------------------------------


-----------------------------------------------------------
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END B -
 for rotation axis 3 and integ. section (b)
-----------------------------------------------------------
From analysis, chord rotation    = 0.01572782
 y = (My*Ls/3)/EIeff = 0.00207761 ((4.29),Biskinis Phd))
  My = 1.1607E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 300.00
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.5865E+012
      factor = 0.70
        Ag = 67500.00
        fc' = 20.00
        N = 809157.043
     Ec*Ig = 7.9807E+012
-----------------------------------------------------------
-----------------------------------------------------------


Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of   y and My according to Annex 7   -
-----------------------------------------------------------
  y = Min(  y_ten,  y_com)
  y_ten = 2.1136989E-005
 with fy = 444.44
     d = 257.00
      y = 0.59092127
     A = 0.18087765
     B = 0.12523344
     with pt = 0.03194564
         pc = 0.03194564
         pv = 0.06975884
         N = 809157.043
         b = 150.00
          " = 0.16731518
  y_comp = 9.3746285E-006
 with fc = 20.00
     Ec = 21019.039
      y = 0.71089008
     A = 0.07237434
     B = 0.0780059
     with Es = 200000.00
-----------------------------------------------------------
```

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 14

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##

Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
       -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
   Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
   Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
     N = 808706.655

fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.0035$
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
    we (5.4c) = 0.00
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
      The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
      of the rectangular sections confinement, which is expressed by (5.4d).
      The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
      "Theoretical Stress-Strain Model for Confined Concrete."
      J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
      Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
        is calculated as the area of core enclosed by the center lines of the perimeter hoops.
      Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
        is calculated by reducing all the dimensions of the area Aconf,max by a length
        equal to half the clear spacing between hoops.
      AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00404182
  Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
    ----
    psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along Y) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
      Lstir (Length of stirrups along X) = 660.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 67500.00
    ----
      s = 190.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.002
    c = confinement factor = 1.00
 y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.

with fs2 = fs = 555.55
        with Es2 = Es = 200000.00
    yv = 0.00231479
    shv = 0.008
   ftv = 666.66
   fyv = 555.55
    suv = 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
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
    2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
    v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
   fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
    2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
    v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->

v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
        fywe = 555.55
        fce = 20.00
      From ((5.A5), TBDY), TBDY: cc = 0.002
         c = confinement factor = 1.00

y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 555.55
    with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->

Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < εs,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 ξcu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω1, ω2, v normalised to bo*do, instead of b*d
  - ε - parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 ξ*cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
 φu = ξcu (4.2) = 2.1436548E-005
Mu = MRo

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 = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization

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of the rectangular sections confinement, which is expressed by (5.4d).
The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
"Theoretical Stress-Strain Model for Confined Concrete."
J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
is calculated as the area of core enclosed by the center lines of the perimeter hoops.
Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
----
psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and ωyv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
ωy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 555.55
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
ωv = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
  εcc (5A.5, TBDY) = 0.002
    λc = confinement factor = 1.00
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
  ω2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
  ωv = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
ωv < ωvs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
ωv < ωs,y1 - LHS eq.(4.7) is not satisfied
--->
ωv < ωvc,y1 - RHS eq.(4.6) is not satisfied
--->
 φcu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, ω1, ω2, ωv normalised to bo*do, instead of b*d
  - λ - parameters of confined concrete, fcc, εcc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 φ*cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 φu = φcu (unconfined full section) = 1.7570028E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
  b = 300.00
  d = 257.00
  d' = 43.00
  v = 0.52445308
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 555.55
  with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
  su2 = 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
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
  suv = 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
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
b = 240.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
  c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied

--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u = cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 538989.858
     Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00

```
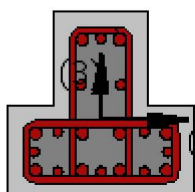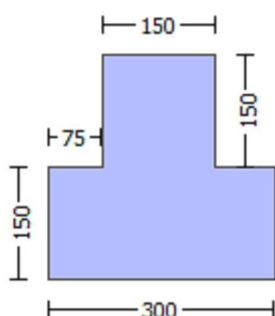    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00
----------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)
----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
----------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 535.426
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00
------------------------------------------------------------
------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3


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


Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties
------------------------------------------------------------
Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
```

```
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
############################################################
```

Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
   -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 1231.504
   -Compression: Asl,com = 1231.504
       -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
   Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
   Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:

b = 150.00
d = 257.00
d' = 43.00
v = 1.04891
   N = 808706.655
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
      fywe = 555.55
       fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.002
         c = confinement factor = 1.00
  y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
  y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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

$su2 = 0.4*esu2\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by $Min(1,1.25*(lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with fs2 = fs = 555.55
 with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
 $suv = 0.4*esuv\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by $Min(1,1.25*(lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with fsv = fs = 555.55
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
b = 90.00
d = 227.00
d' = 13.00
fcc (5A.2, TBDY) = 20.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
- b, d, d' replaced by geometric parameters of the core: bo, do, d'o
- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected

--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00

```
        s = 190.00
     fywe = 555.55
      fce = 20.00
   From ((5.A5), TBDY), TBDY:  cc = 0.002
        c = confinement factor = 1.00
 y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
 y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 555.55
    with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
 and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
        c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
```

Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
         fywe = 555.55
         fce = 20.00
      From ((5.A5), TBDY), TBDY: cc = 0.002
         c = confinement factor = 1.00
   y1 = 0.00231479
   sh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
   su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
   y2 = 0.00231479
   sh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55
   su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00

yv = 0.00231479
      shv = 0.008
    ftv = 666.66
    fyv = 555.55
      suv = 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
         suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
        From table 5A.1, TBDY: esuv_nominal = 0.08,
        considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
        For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
        characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
         y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fsv = fs = 555.55
         with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
      2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
      v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
    cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
      2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
      v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->

```
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =    cu (unconfined full section) =  2.0683116E-005
Mu = MRc
------------------------------------------------------------

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

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 2.0683116E-005
Mu = 2.0480E+008
--------------------------------------------------------------------
with full section properties:
 b = 150.00
 d = 257.00
 d' = 43.00
 v = 1.04891
   N = 808706.655
 fc = 20.00
  co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      --------------------------------------------------------------
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      --------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      --------------------------------------------------------------
        s = 190.00
       fywe = 555.55
       fce = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
```

ft1 = 666.66

fy1 = 555.55

  su1 = 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

    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032

   From table 5A.1, TBDY: esu1_nominal = 0.08,

   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered

   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.

    with fs1 = fs = 555.55

    with Es1 = Es = 200000.00

  y2 = 0.00231479

  sh2 = 0.008

 ft2 = 666.66

 fy2 = 555.55

  su2 = 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

    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

   From table 5A.1, TBDY: esu2_nominal = 0.08,

   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.

    with fs2 = fs = 555.55

    with Es2 = Es = 200000.00

  yv = 0.00231479

  shv = 0.008

 ftv = 666.66

 fyv = 555.55

  suv = 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

    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

   From table 5A.1, TBDY: esuv_nominal = 0.08,

   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY

   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered

   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.

    with fsv = fs = 555.55

    with Esv = Es = 200000.00

  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994

  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994

  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773

and confined core properties:

 b = 90.00

 d = 227.00

 d' = 13.00

 fcc (5A.2, TBDY) = 20.00

  cc (5A.5, TBDY) = 0.002

   c = confinement factor = 1.00

  1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441

  2 = Asl,com/(b*d)*(fs2/fc) = 1.67441

  v = Asl,mid/(b*d)*(fsv/fc) = 3.65636

Case/Assumption: Unconfinesd full section - Steel rupture

 ' does not satisfy Eq. (4.3)

--->

v < vs,c - RHS eq.(4.5) is not satisfied

--->

Case/Assumption Rejected.

--->

New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1,   2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 786.7782
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00

```
        Av = 157079.633
        fy = 444.44
        s = 190.00
      Vs1 is multiplied by   Col1 = 0.00
        s/d = 1.58333
      Vs2 = 73486.813 is calculated for section flange, with:
        d = 240.00
        Av = 157079.633
        fy = 444.44
        s = 190.00
      Vs2 is multiplied by   Col2 = 0.83333333
        s/d = 0.79166667
      Vf ((11-3)-(11.4), ACI 440) = 0.00
      From (11-11), ACI 440: Vs + Vf <= 106950.853
        bw = 150.00
--------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
      = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
      Mu = 1.10406
      Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
      d = 120.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
    Vs1 is multiplied by   Col1 = 0.00
      s/d = 1.58333
    Vs2 = 73486.813 is calculated for section flange, with:
      d = 240.00
      Av = 157079.633
      fy = 444.44
      s = 190.00
    Vs2 is multiplied by   Col2 = 0.83333333
      s/d = 0.79166667
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 106950.853
      bw = 150.00
--------------------------------------------------------------
--------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rctcs

Constant Properties
--------------------------------------------------------------
```

Knowledge Factor, = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.0991E+006
Shear Force, V2 = 48255.683
Shear Force, V3 = 899.0326
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = * u = 0.01195177
  u = y + p = 0.01406091

 - Calculation of y -
----
 y = (My*Ls/3)/Eleff = 0.0060585 ((4.29),Biskinis Phd))
  My = 1.0151E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1222.511
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 6.8279E+012
    factor = 0.70
      Ag = 67500.00
      fc' = 20.00
      N = 809157.043
    Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 2.4971881E-005
 with fy = 444.44

```
        d = 257.00
         y = 0.65374284
         A = 0.18087765
         B = 0.14070525
          with pt = 0.00404182
              pc = 0.02151441
              pv = 0.05346005
              N = 809157.043
              b = 150.00
               " = 0.16731518
     y_comp = 8.2032812E-006
  with fc = 20.00
       Ec = 21019.039
        y = 0.81239814
        A = 0.07237434
        B = 0.09347771
         with Es = 200000.00
```

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of   p -

From table 10-8:   p = 0.00800241
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 1.21438
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises   f to steel strength
   All these variables have already been given in Shear control ratio calculation.
     NUD = 809157.043
     Ag = 67500.00
     f'cE = 20.00
     fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
   b = 150.00
   d = 257.00
     f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 15

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE 41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE 41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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

```
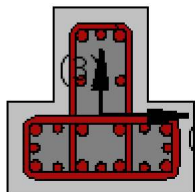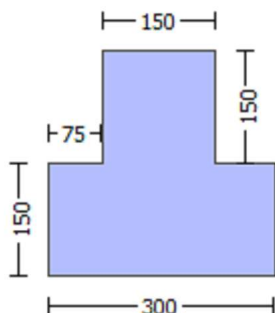------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -5.9160E+006
Shear Force, Va = -899.0326
EDGE -B-
Bending Moment, Mb = 1.0991E+006
Shear Force, Vb = 899.0326
BOTH EDGES
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778
------------------------------------------------------------
------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 104483.818
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 122922.139
   VCol = 122922.139
   knl = 1.00
      displacement_ductility_demand = 0.03356694
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 1.0991E+006
     Vu = 899.0326
  d = 0.8*h = 240.00
  Nu = 809157.043
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 66138.793
  where:
  Vs1 = 66138.793 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 400.00
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 95659.751
    bw = 150.00
------------------------------------------------------------


------------------------------------------------------------
displacement_ductility_demand is calculated as   / y

 - Calculation of   / y for END B -
 for rotation axis 2 and integ. section (b)
------------------------------------------------------------
From analysis, chord rotation    = 0.00020337
 y = (My*Ls/3)/Eleff = 0.0060585 ((4.29),Biskinis Phd))
```

My = 1.0151E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1222.511
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 6.8279E+012
   factor = 0.70
     Ag = 67500.00
     fc' = 20.00
     N = 809157.043
   Ec*Ig = 9.7541E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----

y = Min(y_ten, y_com)
y_ten = 2.4971881E-005
with fy = 444.44
   d = 257.00
   y = 0.65374284
   A = 0.18087765
   B = 0.14070525
   with pt = 0.05867566
     pc = 0.02151441
     pv = 0.05346005
     N = 809157.043
     b = 150.00
     " = 0.16731518
y_comp = 8.2032812E-006
with fc = 20.00
   Ec = 21019.039
   y = 0.81239814
   A = 0.07237434
   B = 0.09347771
   with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 16

column C1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 50 and 51)

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = 1.7373234E-005
EDGE -B-
Shear Force, Vb = -1.7373234E-005
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 2261.947
  -Compression: Asl,com = 829.3805
    -Middle: Asl,mid = 2060.885

Calculation of Shear Capacity ratio , Ve/Vr = 1.21438
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 162563.366
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4385E+008
  Mu1+ = 1.6233E+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- = 2.4385E+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-) = 2.4385E+008
  Mu2+ = 1.6233E+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- = 2.4385E+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

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without

earthquake detailing (90° closed stirrups)

```
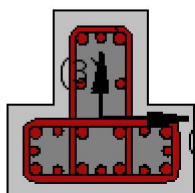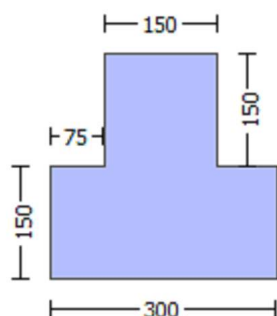------------------------------------------------------------------
    psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
------------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
------------------------------------------------------------------
        s = 190.00
     fywe = 555.55
     fce  = 20.00
   From ((5.A5), TBDY), TBDY:  cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
```

    2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
    v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
     c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 3.07544
   2 = Asl,com/(b*d)*(fs2/fc) = 1.12766
   v = Asl,mid/(b*d)*(fsv/fc) = 2.80207
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.77510846
MRc (4.18) = 1.6233E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.8328476
MRo (4.17) = 9.9542E+007
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 1.7570028E-005
Mu = MRc

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 = 2.1436548E-005
Mu = 2.4385E+008
----
with full section properties:
 b = 300.00
 d = 257.00
 d' = 43.00
 v = 0.52445308
    N = 808706.655
 fc = 20.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
       ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

       ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00

       ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
          s = 190.00
         fywe = 555.55
         fce = 20.00
    From ((5.A5), TBDY), TBDY: εcc = 0.002
         αc = confinement factor = 1.00
   εy1 = 0.00231479
  εsh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  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, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    εy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
   εy2 = 0.00231479
  εsh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55

su2 = 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
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and $y2$, $sh2,ft2,fy2$, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
 2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
 v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
 b = 240.00
 d = 227.00
 d' = 13.00
 fcc (5A.2, TBDY) = 20.00
  cc (5A.5, TBDY) = 0.002
   c = confinement factor = 1.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
 2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
 v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v < s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
 - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
 - N, 1, 2, v normalised to bo*do, instead of b*d
 - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->

v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7570028E-005
Mu = 1.6233E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
              is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
              is calculated by reducing all the dimensions of the area Aconf,max by a length
              equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182

```
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
   ----------------------------------------------------------------
        s = 190.00
      fywe = 555.55
       fce  = 20.00
   From ((5.A5), TBDY):  cc = 0.002
        c  = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and   y1,  sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 555.55
     with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and   y2,  sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 555.55
     with Es2 = Es = 200000.00
  yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and   yv,  shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 555.55
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 1.62986
    2 = Asl,com/(b*d)*(fs2/fc) = 0.59761649
    v = Asl,mid/(b*d)*(fsv/fc) = 1.48499
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
```

 c = confinement factor = 1.00

$\rho 1$ = Asl,ten/(b*d)*(fs1/fc) = 3.07544

$\rho 2$ = Asl,com/(b*d)*(fs2/fc) = 1.12766

ρv = Asl,mid/(b*d)*(fsv/fc) = 2.80207

Case/Assumption: Unconfinesd full section - Steel rupture

' does not satisfy Eq. (4.3)

--->

$\rho v < \rho vs,c$ - RHS eq.(4.5) is not satisfied

--->

Case/Assumption Rejected.

--->

New Case/Assumption: Unconfinesd full section - Spalling of concrete cover

' satisfies Eq. (4.4)

--->

$\rho v < \rho s,y1$ - LHS eq.(4.7) is not satisfied

--->

$\rho v < \rho vc,y1$ - RHS eq.(4.6) is not satisfied

--->

ξcu (4.11) = 0.77510846

MRc (4.18) = 1.6233E+008

--->

New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover

In expressions below, the following modifications have been made

- b, d, d' replaced by geometric parameters of the core: bo, do, d'o

- N, $\rho 1$, $\rho 2$, ρv normalised to bo*do, instead of b*d

- - parameters of confined concrete, fcc, ϵcc, used in lieu of fc, ecu

--->

Subcase: Rupture of tension steel

--->

v* < v*s,y2 - LHS eq.(4.5) is not satisfied

--->

v* < v*s,c - LHS eq.(4.5) is not satisfied

--->

Subcase rejected

--->

New Subcase: Failure of compression zone

--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied

--->

v* < v*c,y1 - RHS eq.(4.6) is satisfied

--->

ξ*cu (4.10) = 0.8328476

MRo (4.17) = 9.9542E+007

MRo < 0.8*MRc

--->

$\varphi u = \varphi cu$ (unconfined full section) = 1.7570028E-005

Mu = MRc

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 = 2.1436548E-005

Mu = 2.4385E+008

----

with full section properties:

b = 300.00

d = 257.00

d' = 43.00

v = 0.52445308
  N = 808706.655
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
         The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
         of the rectangular sections confinement, which is expressed by (5.4d).
         The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
         "Theoretical Stress-Strain Model for Confined Concrete."
         J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
         Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
             is calculated as the area of core enclosed by the center lines of the perimeter hoops.
         Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
             is calculated by reducing all the dimensions of the area Aconf,max by a length
             equal to half the clear spacing between hoops.
         AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00404182
   Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along Y) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
         Lstir (Length of stirrups along X) = 660.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 67500.00
      ----
         s = 190.00
      fywe = 555.55
      fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.002
        c = confinement factor = 1.00
  y1 = 0.00231479
 sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
 su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
  y2 = 0.00231479
 sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
 su2 = 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
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 555.55
   with Es2 = Es = 200000.00
 yv = 0.00231479
 shv = 0.008
ftv = 666.66
fyv = 555.55
 suv = 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
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 555.55
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.29880825
   2 = Asl,com/(b*d)*(fs2/fc) = 0.81493158
   v = Asl,mid/(b*d)*(fsv/fc) = 0.74249322
and confined core properties:
  b = 240.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.4228729
   2 = Asl,com/(b*d)*(fs2/fc) = 1.15329
   v = Asl,mid/(b*d)*(fsv/fc) = 1.05078
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
 ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is satisfied
--->
 cu (4.10) = 0.40464729
MRc (4.17) = 2.6831E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N,   1,   2,   v normalised to bo*do, instead of b*d
  -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->

v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is satisfied
--->
 *cu (4.10) = 0.41100707
MRo (4.17) = 2.4385E+008
--->
  u =   cu (4.2) = 2.1436548E-005
Mu = MRo

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 133865.445

Calculation of Shear Strength at edge 1, Vr1 = 133865.445
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 538989.858
    Vu = 1.7373234E-005
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 73486.813 is calculated for section web, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by   Col1 = 0.83333333
    s/d = 0.79166667
  Vs2 = 0.00 is calculated for section flange, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by   Col2 = 0.00
    s/d = 1.58333
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 133865.445
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 133865.445
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 535.426
   Vu = 1.7373234E-005
d = 0.8*h = 240.00
Nu = 808706.655
Ag = 45000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
where:
Vs1 = 73486.813 is calculated for section web, with:
  d = 240.00
  Av = 157079.633
  fy = 444.44
  s = 190.00
Vs1 is multiplied by   Col1 = 0.83333333
  s/d = 0.79166667
Vs2 = 0.00 is calculated for section flange, with:
  d = 120.00
  Av = 157079.633
  fy = 444.44
  s = 190.00
Vs2 is multiplied by   Col2 = 0.00
  s/d = 1.58333
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 106950.853
  bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -9.8273208E-008
EDGE -B-
Shear Force, Vb = 9.8273208E-008
BOTH EDGES
Axial Force, F = -808706.655
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
         -Middle: Asl,mid = 2689.203

Calculation of Shear Capacity ratio , Ve/Vr = 0.70288134
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 136530.537
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.0480E+008
   Mu1+ = 2.0480E+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- = 2.0480E+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-) = 2.0480E+008
   Mu2+ = 2.0480E+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- = 2.0480E+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

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
   b = 150.00
   d = 257.00
   d' = 43.00
   v = 1.04891
      N = 808706.655
   fc = 20.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.0035
        we (5.4c) = 0.00
        ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
           The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
           of the rectangular sections confinement, which is expressed by (5.4d).
           The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
           "Theoretical Stress-Strain Model for Confined Concrete."
           J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
           Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                 is calculated as the area of core enclosed by the center lines of the perimeter hoops.
           Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and

is calculated by reducing all the dimensions of the area Aconf,max by a length
equal to half the clear spacing between hoops.
AnoConf = 16650.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00404182
Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
----
psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along Y) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
Lstir (Length of stirrups along X) = 660.00
Astir (stirrups area) = 78.53982
Asec (section area) = 67500.00
----
s = 190.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00231479
sh1 = 0.008
ft1 = 666.66
fy1 = 555.55
su1 = 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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 555.55
with Es1 = Es = 200000.00
y2 = 0.00231479
sh2 = 0.008
ft2 = 666.66
fy2 = 555.55
su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 555.55
with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered

characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 555.55
  with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
  2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
  v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N,   1,   2,   v normalised to bo*do, instead of b*d
   -   - parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

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 = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.0035
      ωwe (5.4c) = 0.00
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
          The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
          of the rectangular sections confinement, which is expressed by (5.4d).
          The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
          "Theoretical Stress-Strain Model for Confined Concrete."
          J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
          Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
                is calculated as the area of core enclosed by the center lines of the perimeter hoops.
          Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
                is calculated by reducing all the dimensions of the area Aconf,max by a length
                equal to half the clear spacing between hoops.
          AnoConf = 16650.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00404182
    Expression ((5.4d), TBDY) for ρsh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

      ρsh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along Y) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00

      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
          Lstir (Length of stirrups along X) = 660.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 67500.00
      ----
          s = 190.00
        fywe = 555.55
        fce = 20.00
    From ((5A5), TBDY), TBDY: εcc = 0.002
          αc = confinement factor = 1.00
    εy1 = 0.00231479
    εsh1 = 0.008
  ft1 = 666.66
  fy1 = 555.55
    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 = 555.55

with Es1 = Es = 200000.00
   y2 = 0.00231479
   sh2 = 0.008
  ft2 = 666.66
  fy2 = 555.55
   su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
   yv = 0.00231479
   shv = 0.008
  ftv = 666.66
  fyv = 555.55
   suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
     2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
     v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
   b = 90.00
   d = 227.00
   d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
     2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
     v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o

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- N, 1, 2, v normalised to bo*do, instead of b*d
- - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 2.0683116E-005
Mu = 2.0480E+008
----
with full section properties:
 b = 150.00
 d = 257.00
 d' = 43.00
 v = 1.04891
   N = 808706.655
 fc = 20.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
     we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
               is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
               is calculated by reducing all the dimensions of the area Aconf,max by a length
               equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)

```
        psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along Y) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
    ----------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
            Lstir (Length of stirrups along X) = 660.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 67500.00
    ----------------------------------------------------------------
            s = 190.00
        fywe = 555.55
         fce = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.002
            c = confinement factor = 1.00
   y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 555.55
      with Es1 = Es = 200000.00
   y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 555.55
      with Es2 = Es = 200000.00
   yv = 0.00231479
  shv = 0.008
 ftv = 666.66
 fyv = 555.55
  suv = 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
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 555.55
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
   2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
   v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
```

and confined core properties:
    b = 90.00
    d = 227.00
    d' = 13.00
    fcc (5A.2, TBDY) = 20.00
      cc (5A.5, TBDY) = 0.002
        c = confinement factor = 1.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
      2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
      v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
  cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
   - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
   - N,   1,   2,   v normalised to bo*do, instead of b*d
   -   -   parameters of confined concrete, fcc,   cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->
v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
  *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
  u =   cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.0683116E-005

Mu = 2.0480E+008

----

with full section properties:
  b = 150.00
  d = 257.00
  d' = 43.00
  v = 1.04891
    N = 808706.655
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.0035$
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.0035
      we (5.4c) = 0.00
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.00
        The definitions of AnoConf, Aconf,min and Aconf,max are derived from generalization
        of the rectangular sections confinement, which is expressed by (5.4d).
        The generalization is done according to Mander, J., Priestley, M., and Park, R. (1988)
        "Theoretical Stress-Strain Model for Confined Concrete."
        J. Struct. Eng., 10.1061/(ASCE)0733-9445(1988)114:8(1804), 1804-1826.
        Aconf,max = 35100.00 is the confined core area at levels of member with hoops and
           is calculated as the area of core enclosed by the center lines of the perimeter hoops.
        Aconf,min = 0.00 is the confined core area at midway between the levels of hoops and
           is calculated by reducing all the dimensions of the area Aconf,max by a length
           equal to half the clear spacing between hoops.
        AnoConf = 16650.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00404182
    Expression ((5.4d), TBDY) for psh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
      ----
      psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along Y) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00404182
        Lstir (Length of stirrups along X) = 660.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 67500.00
      ----
        s = 190.00
       fywe = 555.55
       fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.002
      c = confinement factor = 1.00
  y1 = 0.00231479
  sh1 = 0.008
 ft1 = 666.66
 fy1 = 555.55
  su1 = 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
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 555.55
    with Es1 = Es = 200000.00
  y2 = 0.00231479
  sh2 = 0.008
 ft2 = 666.66
 fy2 = 555.55
  su2 = 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
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 555.55
  with Es2 = Es = 200000.00
yv = 0.00231479
shv = 0.008
ftv = 666.66
fyv = 555.55
suv = 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
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 555.55
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.88736994
  2 = Asl,com/(b*d)*(fs2/fc) = 0.88736994
  v = Asl,mid/(b*d)*(fsv/fc) = 1.93773
and confined core properties:
  b = 90.00
  d = 227.00
  d' = 13.00
  fcc (5A.2, TBDY) = 20.00
   cc (5A.5, TBDY) = 0.002
      c = confinement factor = 1.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 1.67441
   2 = Asl,com/(b*d)*(fs2/fc) = 1.67441
   v = Asl,mid/(b*d)*(fsv/fc) = 3.65636
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is not satisfied
--->
Case/Assumption Rejected.
--->
New Case/Assumption: Unconfinesd full section - Spalling of concrete cover
  ' satisfies Eq. (4.4)
--->
v <   s,y1 - LHS eq.(4.7) is not satisfied
--->
v < vc,y1 - RHS eq.(4.6) is not satisfied
--->
 cu (4.11) = 0.65844416
MRc (4.18) = 2.0480E+008
--->
New Case/Assumption: Ultimate curvature of confined core after spalling of concrete cover
In expressions below, the following modifications have been made
  - b, d, d' replaced by geometric parameters of the core: bo, do, d'o
  - N, 1, 2, v normalised to bo*do, instead of b*d
  - - parameters of confined concrete, fcc, cc, used in lieu of fc, ecu
--->
Subcase: Rupture of tension steel
--->
v* < v*s,y2 - LHS eq.(4.5) is not satisfied
--->

v* < v*s,c - LHS eq.(4.5) is not satisfied
--->
Subcase rejected
--->
New Subcase: Failure of compression zone
--->
v* < v*c,y2 - LHS eq.(4.6) is not satisfied
--->
v* < v*c,y1 - RHS eq.(4.6) is not satisfied
--->
 *cu (4.11) = 0.66611064
MRo (4.18) = 1.4457E+008
MRo < 0.8*MRc
--->
 u = cu (unconfined full section) = 2.0683116E-005
Mu = MRc

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 194244.077

Calculation of Shear Strength at edge 1, Vr1 = 194244.077
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077
  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 786.7782
     Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
     d = 120.00
     Av = 157079.633
     fy = 444.44
     s = 190.00
  Vs1 is multiplied by   Col1 = 0.00
     s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
     d = 240.00
     Av = 157079.633
     fy = 444.44
     s = 190.00
  Vs2 is multiplied by   Col2 = 0.83333333
     s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
     bw = 150.00

Calculation of Shear Strength at edge 2, Vr2 = 194244.077
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 194244.077

knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 1.10406
    Vu = 9.8273208E-008
  d = 0.8*h = 240.00
  Nu = 808706.655
  Ag = 45000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 73486.813
  where:
  Vs1 = 0.00 is calculated for section web, with:
    d = 120.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs1 is multiplied by Col1 = 0.00
    s/d = 1.58333
  Vs2 = 73486.813 is calculated for section flange, with:
    d = 240.00
    Av = 157079.633
    fy = 444.44
    s = 190.00
  Vs2 is multiplied by Col2 = 0.83333333
    s/d = 0.79166667
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 106950.853
    bw = 150.00

End Of Calculation of Shear Capacity ratio for element: column TC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rctcs

Constant Properties

Knowledge Factor,   = 0.85
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 300.00
Min Height, Hmin = 150.00
Max Width, Wmax = 300.00
Min Width, Wmin = 150.00
Eccentricity, Ecc = 75.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Smooth Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not 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 = -1.0196E+007
Shear Force, V2 = 48255.683
Shear Force, V3 = 899.0326
Axial Force, F = -809157.043
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
         -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = *θu = 0.00856802
 θu = θy + θp = 0.01008002

 - Calculation of θy -

 θy = (My*Ls/3)/EIeff = 0.00207761 ((4.29),Biskinis Phd))
  My = 1.1607E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 300.00
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.5865E+012
     factor = 0.70
        Ag = 67500.00
        fc' = 20.00
        N = 809157.043
     Ec*Ig = 7.9807E+012

Calculation of Yielding Moment My

Calculation of φy and My according to Annex 7 -

 φy = Min(φy_ten, φy_com)
  φy_ten = 2.1136989E-005
 with fy = 444.44
     d = 257.00
     ξy = 0.59092127
     A = 0.18087765
     B = 0.12523344
      with pt = 0.00404182
         pc = 0.03194564
         pv = 0.06975884
         N = 809157.043
         b = 150.00
          " = 0.16731518
  φy_comp = 9.3746285E-006
 with fc = 20.00
     Ec = 21019.039
     ξy = 0.71089008
     A = 0.07237434
     B = 0.0780059
      with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of   p -

From table 10-8:   p = 0.00800241
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VCol0E = 0.70288134
   d = 257.00
   s = 150.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00404182
   Av = 78.53982, is the area of every stirrup
   Lstir = 660.00, is the total Length of all stirrups parallel to loading (shear) direction
   The term 2*tf/bw*(ffe/fs) is implemented to account for FRP contribution
   where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
   All these variables have already been given in Shear control ratio calculation.
    NUD = 809157.043
    Ag = 67500.00
    f'cE = 20.00
    fytE = fylE = 444.44
pl = Area_Tot_Long_Rein/(b*d) = 0.13365012
   b = 150.00
   d = 257.00
    f'cE = 20.00

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)