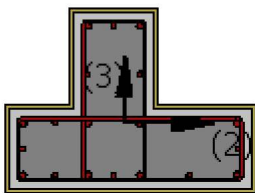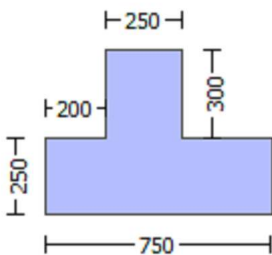# Detailed Member Calculations

**Units: N & mm**

**Regulation: ASCE 41-17**

## Calculation No. 1

column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)



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

Constant Properties
------------------------------------------------------------
Knowledge Factor, = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00
##########################################################
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##########################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.4205E+007
Shear Force, Va = -4666.206
EDGE -B-
Bending Moment, Mb = 203483.692
Shear Force, Vb = 4666.206
BOTH EDGES
Axial Force, F = -10489.234
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
---------------------------------------------------------------
---------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 592688.698
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 592688.698
   VCol = 592688.698
   knl = 1.00
      displacement_ductility_demand = 0.01457762
---------------------------------------------------------------
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' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 1.4205E+007
   Vu = 4666.206
 d = 0.8*h = 600.00
 Nu = 10489.234
 Ag = 187500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 628318.531
 where:
 Vs1 = 157079.633 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
 Vs1 is multiplied by  Col1 = 1.00
  s/d = 0.50
 Vs2 = 471238.898 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
 Vs2 is multiplied by  Col2 = 1.00
  s/d = 0.16666667
 Vf ((11-3)-(11.4), ACI 440) = 372533.843
  f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 498227.872
  bw = 250.00
----------------------------------------------------------------

----------------------------------------------------------------
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 = 7.7218328E-005
 y = (My*Ls/3)/Eleff = 0.00529705 ((4.29),Biskinis Phd))
 My = 3.9379E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3044.27
 From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 7.5439E+013
  factor = 0.30
   Ag = 262500.00
   fc' = 33.00
   N = 10489.234
  Ec*Ig = 2.5146E+014
-----------------------------------------------------------------
-----------------------------------------------------------------

Calculation of Yielding Moment My
----------------------------------------------------------------
Calculation of y and My according to Annex 7 -
----------------------------------------------------------------
 y = Min( y_ten, y_com)
 y_ten = 3.1942884E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112

d = 707.00
         y = 0.31098033
        A = 0.0293404
        B = 0.015652
         with pt = 0.00696749
            pc = 0.00696749
            pv = 0.01521473
            N = 10489.234
            b = 250.00
            " = 0.06082037
     y_comp = 1.0098300E-005
    with fc* (12.3, (ACI 440)) = 33.16756
        fc = 33.00
        fl = 0.56655003
        b = bmax = 750.00
        h = hmax = 550.00
        Ag = 262500.00
            g = pt + pc + pv = 0.02914971
           rc = 40.00
           Ae/Ac = 0.17542991
           Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        effective strain from (12.5) and (12.12), efe = 0.004
         fu = 0.01
       Ef = 64828.00
      Ec = 26999.444
       y = 0.30971595
      A = 0.02901552
      B = 0.01546131
       with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)

-----------------------------------------------------------
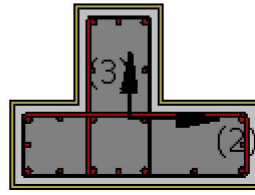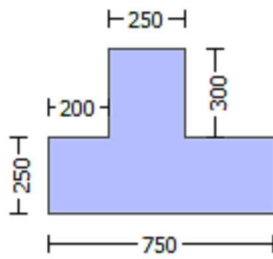
# Calculation No. 2

column C1, Floor 1

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

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,    = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-----------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-

Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.9036E+008
  Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
  Mu2+ = 5.9036E+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- = 2.9749E+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 = 1.2706712E-005
Mu = 5.9036E+008
----------------------------------------------------------------------
with full section properties:
 b = 750.00
 d = 507.00
 d' = 43.00
 v = 0.00078635
  N = 9867.331
 fc = 33.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: εcu = 0.01138103
    ρwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ρfx, ρfy) = 0.03881913
   where ρf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
    ρfx = 0.02979558
   Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
   αf = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
    bmax = 750.00
    hmax = 550.00
    From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
     bw = 250.00
    effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
    ρfy = 0.02979558
   Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
   αf = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 750.00

hmax = 550.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
-----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
-----------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
b = 690.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c  = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
u =    su (4.1) = 1.2706712E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
--------------------------------------------------------------------
with full section properties:
b = 250.00
d = 507.00
d' = 43.00
v = 0.00235905
N = 9867.331
fc = 33.00

co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01138103
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
  where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  ------------------------------------------------------------------
    fx = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
    bmax = 750.00
    hmax = 550.00
    From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
      bw = 250.00
    effective stress from (A.35), ff,e = 809.387
  ------------------------------------------------------------------
    fy = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 750.00
    hmax = 550.00
    From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
      bw = 250.00
    effective stress from (A.35), ff,e = 809.387
  ------------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
      Lstir (Length of stirrups along Y) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
  ------------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
      Lstir (Length of stirrups along X) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
  ------------------------------------------------------------------
      s = 100.00
    fywe = 694.45
    fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00238888
      c = confinement factor = 1.03889
  y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139

su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
   y2 = 0.00140044
   sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
   su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
   yv = 0.00140044
   shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
   suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
   v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  u =    su (4.1) = 1.2514519E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------------


------------------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2706712E-005
Mu = 5.9036E+008
------------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387
     ----------------------------------------------------------------
       fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 750.00
       hmax = 550.00
       From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387
     ----------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
          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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00406911

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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

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

    s = 100.00
   fywe = 694.45
   fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00

ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
ρv = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   εcc (5A.5, TBDY) = 0.00238888
    λc = confinement factor = 1.03889
   ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
   ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
   ρv = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
ρv < ρvs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 φu = φsu (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.2514519E-005
Mu = 2.9749E+008
--------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
   N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
     ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    --------------------------------------------------------------
     ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
     bmax = 750.00
     hmax = 550.00
     From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
      bw = 250.00
     effective stress from (A.35), ff,e = 809.387
    --------------------------------------------------------------
     ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
     bmax = 750.00
     hmax = 550.00

From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
   bw = 250.00
effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
-----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
-----------------------------------------------------------------
   s = 100.00
   fywe = 694.45
   fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
   c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   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 εy2, εsh2,εft2,εfy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
εy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
εyv = 0.00140044
εshv = 0.0044814
ftv = 466.8167
fyv = 389.0139
εsuv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and εyv, εshv,εftv,εfyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
b = 190.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
εcc (5A.5, TBDY) = 0.00238888
αc = confinement factor = 1.03889
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
 εv < εs,y2 - LHS eq.(4.5) is satisfied
--->
εsu (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
φu = φsu (4.1) = 1.2514519E-005
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
---------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
VCol0 = 499463.254
knl = 1 (zero step-static loading)
-----------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ φf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------
λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
Mu = 21.4831
Vu = 6.0494360E-005

d = 0.8*h = 440.00
Nu = 9867.331
Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 383975.507 is calculated for section web, with:
  d = 440.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.22727273
Vs2 = 174534.321 is calculated for section flange, with:
  d = 200.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 267149.446
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 419774.846
  bw = 250.00
------------------------------------------------------------
-------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 499463.254
 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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
  Mu = 21.68208
  Vu = 6.0494360E-005
 d = 0.8*h = 440.00
 Nu = 9867.331
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
 where:
 Vs1 = 383975.507 is calculated for section web, with:
  d = 440.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
 Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.22727273
 Vs2 = 174534.321 is calculated for section flange, with:
  d = 200.00
  Av = 157079.633
  fy = 555.56

s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, = 45° and = -45° to take into consideration the cyclic seismic loading.
  orientation 1: 1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00

Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
  Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
  Mu2+ = 5.7828E+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- = 5.7828E+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 $\varphi$u according to 4.1, Biskinis/Fardis 2013:
 $\varphi$u = 9.2773974E-006
Mu = 5.7828E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  $\nu$ = 0.00169171
    N = 9867.331
  fc = 33.00
   $\varepsilon$co (5A.5, TBDY) = 0.002
  Final value of $\varepsilon$cu: $\varepsilon$cu* = shear_factor * Max($\varepsilon$cu, $\varepsilon$cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: $\varepsilon$cu = 0.01138103
      $\omega$we ((5.4c), TBDY) = $\alpha$se* $\rho$sh,min*fywe/fce+Min($\omega$fx, $\omega$fy) = 0.03881913
    where $\omega$f = $\alpha$f*$\rho$f*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     --------------------------------------------------------------
     $\omega$fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as $\alpha$f = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
   effective stress from (A.35), ff,e = 809.387
------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
   effective stress from (A.35), ff,e = 809.387
------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   ------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   ------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
 2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
 v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
 cc (5A.5, TBDY) = 0.00238888
  c = confinement factor = 1.03889
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
 2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
 v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u = su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu1-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591

Lstir (Length of stirrups along X) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 262500.00

        -----------------------------------------------------------------
          s = 100.00
       fywe = 694.45
        fce  = 33.00
     From ((5.A5), TBDY):  cc = 0.00238888
        c  = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888

```
      c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu2+
-------------------------------------------------------------------------

-------------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
-------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,   fy) = 0.03881913
     where    f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     -------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     -------------------------------------------------------------
       fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 750.00
        hmax = 550.00
        From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     -------------------------------------------------------------
        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
```

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
      Lstir (Length of stirrups along Y) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
   ------------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
      Lstir (Length of stirrups along X) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
   ------------------------------------------------------------------
      s = 100.00
      fywe = 694.45
      fce  = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00238888
      c  = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139

$\epsilon$suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   $\epsilon$suv = 0.4*$\epsilon$suv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: $\epsilon$suv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of $\epsilon$suv_nominal and $\epsilon$yv, $\epsilon$shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   $\epsilon$y1, $\epsilon$sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  $\omega$1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  $\omega$2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  $\omega$v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  $\epsilon$cc (5A.5, TBDY) = 0.00238888
   c = confinement factor = 1.03889
  $\omega$1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  $\omega$2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  $\omega$v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
$\omega$v < $\omega$vs,y2 - LHS eq.(4.5) is satisfied
--->
 $\epsilon$su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 $\varphi$u = $\varphi$su (4.1) = 9.2773974E-006
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu2-
-----------------------------------------------------------------------

-----------------------------------------------------------------------
Calculation of ultimate curvature $\varphi$u according to 4.1, Biskinis/Fardis 2013:
 $\varphi$u = 9.2773974E-006
Mu = 5.7828E+008
-----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  $\nu$ = 0.00169171
   N = 9867.331
  fc = 33.00
  $\epsilon$co (5A.5, TBDY) = 0.002
  Final value of $\epsilon$cu: $\epsilon$cu* = shear_factor * Max($\epsilon$cu, $\epsilon$cc) = 0.01138103
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: $\epsilon$cu = 0.01138103
   $\omega$we ((5.4c), TBDY) = $\alpha$se*$\rho$sh,min*fywe/fce+Min($\omega$fx, $\omega$fy) = 0.03881913
  where $\omega$f = $\alpha$f*$\rho$f*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  -----------------------------------------------------------------
   $\omega$fx = 0.02979558
  Expression ((15B.6), TBDY) is modified as $\alpha$f = 1 - (Unconfined area)/(total area)
  $\alpha$f = 0.14946032

with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
      Lstir (Length of stirrups along Y) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    -----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
      Lstir (Length of stirrups along X) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    -----------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c  = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.

with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
u = su (4.1) = 9.2773974E-006
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
------------------------------------------------------------------------------

Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\phi_f$*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
    $\lambda$ = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by $\alpha$Col1 = 1.00
    s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by $\alpha$Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
    $\psi_f$ = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin $\alpha$ + cos $\alpha$ is replaced with (cot$\theta$ +cota)sina which is more a generalised expression,
  where $\theta$ is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf($\theta$, $\alpha$), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, $\theta$=45° and $\theta$=-45° to take into consideration the cyclic seismic loading.
  orientation 1:  $\alpha$1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, $\alpha$1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    $\epsilon$fe = 0.004, from (11.6a), ACI 440
      with $\epsilon$fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\phi_f$*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
    $\lambda$ = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.0587
    Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  = 45° and  = -45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
------------------------------------------------------------
------------------------------------------------------------
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,  = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)

Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = -335583.449
Shear Force, V2 = -4666.206
Shear Force, V3 = 169.2694
Axial Force, F = -10489.234
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
---------------------------------------------------------------
---------------------------------------------------------------

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta$u,R = 1.0* $\theta$u = 0.00599518
  $\theta$u = $\theta$y + $\theta$p = 0.00599518

---------------------------------------------------------------
 - Calculation of $\theta$y -
---------------------------------------------------------------
 $\theta$y = (My*Ls/3)/EIeff = 0.00599518 ((4.29),Biskinis Phd))
  My = 4.1079E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1982.54
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 4.5281E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 33.00
        N = 10489.234
     Ec*Ig = 1.5094E+014
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of $\theta$y and My according to Annex 7  -
---------------------------------------------------------------
Assuming neutral axis within flange ( $\xi$y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
---------------------------------------------------------------
  $\xi$y = Min( $\xi$y_ten, $\xi$y_com)
  $\xi$y_ten = 4.2686120E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 507.00
      $\alpha$y = 0.28099731
     A = 0.01363818
     B = 0.00916195

with pt = 0.00594858
          pc = 0.00218115
          pv = 0.00541982
          N = 10489.234
          b = 750.00
           " = 0.08481262
   y_comp = 1.5576756E-005
  with fc* (12.3, (ACI 440)) = 33.18002
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        g = pt + pc + pv = 0.01354954
       rc = 40.00
       Ae/Ac = 0.18847004
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
     Ef = 64828.00
     Ec = 26999.444
      y = 0.28009758
     A = 0.01348719
     B = 0.00907331
     with Es = 200000.00
CONFIRMATION:  y = 0.28045299 < t/d
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30


-----------------------------------------------------------
 - 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/VColOE = 0.78798666
   d = 507.00
   s = 0.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
   Av = 78.53982, is the area of every stirrup
   Lstir = 1360.00, 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 = 10489.234
   Ag = 262500.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01354954
  b = 750.00
  d = 507.00
   f'cE = 33.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)


-----------------------------------------------------------
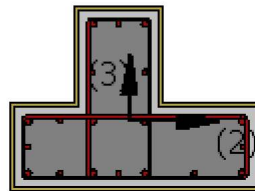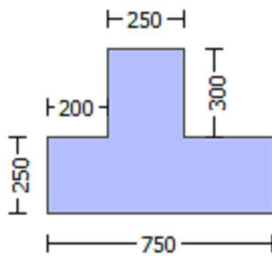
# Calculation No. 3

column C1, Floor 1

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

Analysis: Uniform + X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)



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

Constant Properties
-------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel

Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -335583.449
Shear Force, Va = 169.2694
EDGE -B-
Bending Moment, Mb = -171486.715
Shear Force, Vb = -169.2694
BOTH EDGES
Axial Force, F = -10489.234
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 434914.452
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 434914.452
   VCol = 434914.452
   knl = 1.00
      displacement_ductility_demand = 0.00314254
-------------------------------------------------------------
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' = 25.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 335583.449
     Vu = 169.2694
  d = 0.8*h = 440.00
  Nu = 10489.234
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
  where:
  Vs1 = 345575.192 is calculated for section web, with:
     d = 440.00
     Av = 157079.633
     fy = 500.00
     s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
     s/d = 0.22727273
  Vs2 = 157079.633 is calculated for section flange, with:
     d = 200.00
     Av = 157079.633

```
        fy = 500.00
        s = 100.00
    Vs2 is multiplied by   Col2 = 1.00
        s/d = 0.50
    Vf ((11-3)-(11.4), ACI 440) = 267149.446
        f = 0.95, for fully-wrapped sections
    wf/sf = 1 (FRP strips adjacent to one another).
    In (11.3) sin  + cos   is replaced with (cot +cota)sina which is more a generalised expression,
    where    is the angle of the crack direction (see KANEPE).
    This later relation, considered as a function Vf( ,  ), is implemented for every different fiber orientation ai,
    as well as for 2 crack directions,   =45° and   =-45° to take into consideration the cyclic seismic loading.
    orientation 1:   1 = b1 + 90° = 90.00
    Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
    total thickness per orientation, tf1 = NL*t/NoDir = 1.016
    dfv = d (figure 11.2, ACI 440) = 507.00
    ffe ((11-5), ACI 440) = 259.312
        Ef = 64828.00
         fe = 0.004, from (11.6a), ACI 440
          with  fu = 0.01
    From (11-11), ACI 440: Vs + Vf < = 365367.106
        bw = 250.00
-----------------------------------------------------------

-----------------------------------------------------------
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    = 1.8840103E-005
  y = (My*Ls/3)/Eleff = 0.00599518 ((4.29),Biskinis Phd))
   My = 4.1079E+008
   Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1982.54
   From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 4.5281E+013
       factor = 0.30
         Ag = 262500.00
         fc' = 33.00
         N = 10489.234
      Ec*Ig = 1.5094E+014
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of   y and My according to Annex 7   -
-----------------------------------------------------------
Assuming neutral axis within flange (  y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
-----------------------------------------------------------
   y = Min(  y_ten,  y_com)
   y_ten = 4.2686120E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 507.00
       y = 0.28099731
     A = 0.01363818
     B = 0.00916195
      with pt = 0.00594858
          pc = 0.00218115
          pv = 0.00541982
          N = 10489.234
          b = 750.00
           " = 0.08481262
   y_comp = 1.5576756E-005
  with fc* (12.3, (ACI 440)) = 33.18002
     fc = 33.00
```

```
    fl = 0.56655003
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
        g = pt + pc + pv = 0.01354954
        rc = 40.00
        Ae/Ac = 0.18847004
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.01
    Ef = 64828.00
    Ec = 26999.444
     y = 0.28009758
    A = 0.01348719
    B = 0.00907331
     with Es = 200000.00
CONFIRMATION:   y = 0.28045299 < t/d
---------------------------------------------------------
---------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)


---------------------------------------------------------
```
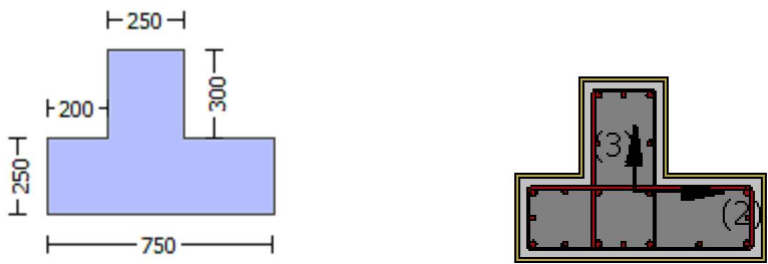
## Calculation No. 4

column C1, Floor 1

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

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,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.78798666

Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.9036E+008
  Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
  Mu2+ = 5.9036E+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- = 2.9749E+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  $\phi u$ according to 4.1, Biskinis/Fardis 2013:
  $\phi u$ = 1.2706712E-005
Mu = 5.9036E+008
--------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   $\epsilon co$ (5A.5, TBDY) = 0.002
  Final value of $\epsilon cu$: $\epsilon cu$* = shear_factor * Max($\epsilon cu$, $\epsilon cc$) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: $\epsilon cu$ = 0.01138103
      $\omega we$ ((5.4c), TBDY) = $\alpha se$*$\rho sh,min$*fywe/fce+Min($\omega fx$, $\omega fy$) = 0.03881913
    where $\omega f = \alpha f*\rho f*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      $\omega fx$ = 0.02979558
    Expression ((15B.6), TBDY) is modified as $\alpha f$ = 1 - (Unconfined area)/(total area)
    $\alpha f$ = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      $\omega fy$ = 0.02979558
    Expression ((15B.6), TBDY) is modified as $\alpha f$ = 1 - (Unconfined area)/(total area)
    $\alpha f$ = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       $\epsilon u,f$ = 0.015
      $\alpha se$ = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
------------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
------------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY, TBDY:  cc = 0.00238888
   c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30

εsuv = 0.4*εsuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: εsuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of εsuv_nominal and ωyv, ωshv,ωftv,ωfyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
ωy1, ωsh1,ωft1,ωfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   εcc (5A.5, TBDY) = 0.00238888
     λc = confinement factor = 1.03889
    ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
    ω2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
    ωv = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
ωv < ωvs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 φu = φsu (4.1) = 1.2706712E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu1-
-------------------------------------------------------------------------

-------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.2514519E-005
Mu = 2.9749E+008
-------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ωsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -------------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
         bw = 250.00

effective stress from (A.35), ff,e = 809.387

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

fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
      bw = 250.00
   effective stress from (A.35), ff,e = 809.387

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

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

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

   s = 100.00
   fywe = 694.45
   fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
   c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167

fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
    v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  u =    su (4.1) = 1.2514519E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2706712E-005
Mu = 5.9036E+008
--------------------------------------------------------------------

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with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+ Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -----------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
        s = 100.00
      fywe = 694.45

fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
b = 690.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)

```
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
   u =   su (4.1) = 1.2706712E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 1.2514519E-005
Mu = 2.9749E+008
---------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:   cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
          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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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 ℇyv, εshv,εftv,εfyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
ℇy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  εcc (5A.5, TBDY) = 0.00238888
    λc = confinement factor = 1.03889
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
  ω2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
  ωv = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
ωv < ωvs,y2 - LHS eq.(4.5) is satisfied
--->
ℇsu (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
φu = φsu (4.1) = 1.2514519E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
-----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.4831
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by λCol1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633

fy = 555.56
    s = 100.00
 Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 419774.846
    bw = 250.00
----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 21.68208
     Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312

Ef = 64828.00
          fe = 0.004, from (11.6a), ACI 440
            with   fu = 0.01
      From (11-11), ACI 440: Vs + Vf <= 419774.846
        bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------
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,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
#############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES

Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
 Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
 Mu2+ = 5.7828E+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- = 5.7828E+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 = 9.2773974E-006
Mu = 5.7828E+008
---------------------------------------------------------------------------
with full section properties:
 b = 250.00
 d = 707.00
 d' = 43.00
 v = 0.00169171
  N = 9867.331
 fc = 33.00
 co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY:  cu = 0.01138103
   we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
  where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  -----------------------------------------------------------------
   fx = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
   effective stress from (A.35), ff,e = 809.387
  -----------------------------------------------------------------
   fy = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128

bw = 250.00
effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
-----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
-----------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
    c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =    su (4.1) = 9.2773974E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu1-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
   N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.01138103
we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
-------------------------------------------------------------------
fx = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
bmax = 750.00
hmax = 550.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 809.387
-------------------------------------------------------------------
fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
bmax = 750.00
hmax = 550.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
bw = 250.00
effective stress from (A.35), ff,e = 809.387
-------------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
-------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
-------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c  = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
u =   su (4.1) = 9.2773974E-006
----------------------------------------------------------

Calculation of ratio lb/ld

------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------

------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.2773974E-006
Mu = 5.7828E+008
------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
-----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
-----------------------------------------------------------------
        s = 100.00
     fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.00448140
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.00448140
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.00448140
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
   2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
```

v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
       c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
     2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
     v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
   u =    su (4.1) = 9.2773974E-006
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 707.00
   d' = 43.00
   v = 0.00169171
     N = 9867.331
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01138103
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----------------------------------------------------------------
         fx = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
         bmax = 750.00
         hmax = 550.00
         From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
           bw = 250.00
         effective stress from (A.35), ff,e = 809.387
      ----------------------------------------------------------------
         fy = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 750.00
         hmax = 550.00
         From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
           bw = 250.00

effective stress from (A.35), ff,e = 809.387

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

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00

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

    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00

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

        s = 100.00
        fywe = 694.45
        fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c  = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
    c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331

Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
where:
Vs1 = 174534.321 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.50
Vs2 = 523602.964 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 372533.843
  $\psi_f$ = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin $\beta$ + cos $\beta$ is replaced with (cot $\theta$ + cota)sina which is more a generalised expression,
where $\theta$ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf($\theta$, $\alpha$), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, $\theta$ = 45° and $\theta$ = -45° to take into consideration the cyclic seismic loading.
orientation 1:  $\alpha 1$ = b1 + 90° = 90.00
Vf = Min(|Vf(45, $\alpha 1$)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   $\varepsilon_{fe}$ = 0.004, from (11.6a), ACI 440
     with $\varepsilon_{fu}$ = 0.01
From (11-11), ACI 440: Vs + Vf <= 572420.244
  bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\psi_f$*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
  $\lambda$ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
  Mu = 106.0587
  Vu = 0.00038514
d = 0.8*h = 600.00
Nu = 9867.331
Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
where:
Vs1 = 174534.321 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.50
Vs2 = 523602.964 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00

s/d = 0.16666667
    Vf ((11-3)-(11.4), ACI 440) = 372533.843
      f = 0.95, for fully-wrapped sections
    wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
   where is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions, = 45° and = -45° to take into consideration the cyclic seismic loading.
   orientation 1:   1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
   total thickness per orientation, tf1 = NL*t/NoDir = 1.016
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
       fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.01
    From (11-11), ACI 440: Vs + Vf <= 572420.244
      bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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,    = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------
Bending Moment, M = -1.4205E+007
Shear Force, V2 = -4666.206
Shear Force, V3 = 169.2694
Axial Force, F = -10489.234
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
-----------------------------------------------------------
-----------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   $\theta_{u,R}$ = 1.0* $\theta_u$ = 0.00529705
 $\theta_u$ = $\theta_y$ + $\theta_p$ = 0.00529705


-----------------------------------------------------------
 - Calculation of $\theta_y$ -
-----------------------------------------------------------
 $\theta_y$ = (My*Ls/3)/Eleff = 0.00529705 ((4.29),Biskinis Phd))
 My = 3.9379E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3044.27
 From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 7.5439E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 33.00
       N = 10489.234
    Ec*Ig = 2.5146E+014
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of $\theta_y$ and My according to Annex 7   -
-----------------------------------------------------------
 $\theta_y$ = Min( $\theta_y$_ten, $\theta_y$_com)
 $\theta_y$_ten = 3.1942884E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112
    d = 707.00
     $\phi_y$ = 0.31098033
    A = 0.0293404
    B = 0.015652
     with pt = 0.00696749
        pc = 0.00696749
        pv = 0.01521473
        N = 10489.234
        b = 250.00
         " = 0.06082037
 $\theta_y$_comp = 1.0098300E-005
 with fc* (12.3, (ACI 440)) = 33.16756
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
         g = pt + pc + pv = 0.02914971
      rc = 40.00
      Ae/Ac = 0.17542991
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
     Ef = 64828.00

Ec = 26999.444
 y = 0.30971595
A = 0.02901552
B = 0.01546131
 with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30

-----------------------------------------------------------
 - 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 = 0.56632982
  d = 707.00
  s = 0.00
   t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
  Av = 78.53982, is the area of every stirrup
  Lstir = 1760.00, 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 = 10489.234
   Ag = 262500.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
  b = 250.00
  d = 707.00
   f'cE = 33.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)

-----------------------------------------------------------
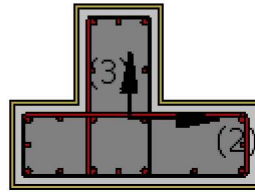
# Calculation No. 5

column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

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

Constant Properties
------------------------------------------------------------
Knowledge Factor,     = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.4205E+007

Shear Force, Va = -4666.206
EDGE -B-
Bending Moment, Mb = 203483.692
Shear Force, Vb = 4666.206
BOTH EDGES
Axial Force, F = -10489.234
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 687149.523
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 687149.523
  VCol = 687149.523
  knl = 1.00
    displacement_ductility_demand = 0.05569654
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\psi_f$*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
   $\lambda$ = 1 (normal-weight concrete)
 fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
  Mu = 203483.692
  Vu = 4666.206
 d = 0.8*h = 600.00
 Nu = 10489.234
 Ag = 187500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 628318.531
 where:
 Vs1 = 157079.633 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
 Vs1 is multiplied by $\lambda$Col1 = 1.00
  s/d = 0.50
 Vs2 = 471238.898 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
 Vs2 is multiplied by $\lambda$Col2 = 1.00
  s/d = 0.16666667
 Vf ((11-3)-(11.4), ACI 440) = 372533.843
  $\psi_f$ = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin$\beta$ + cos$\beta$ is replaced with (cot$\theta$ +cota)sina which is more a generalised expression,
 where $\theta$ is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf($\theta$, $\beta$), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions, $\theta$=45° and $\theta$=-45° to take into consideration the cyclic seismic loading.
 orientation 1: $\beta$1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45, $\beta$1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 707.00
 ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
  $\epsilon$fe = 0.004, from (11.6a), ACI 440
   with $\epsilon$fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 498227.872

```
      bw = 250.00
--------------------------------------------------------------


--------------------------------------------------------------
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    = 2.9073688E-005
  y = (My*Ls/3)/EIeff = 0.000522 ((4.29),Biskinis Phd))
   My = 3.9379E+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 = 7.5439E+013
      factor = 0.30
        Ag = 262500.00
        fc' = 33.00
        N = 10489.234
     Ec*Ig = 2.5146E+014
--------------------------------------------------------------
--------------------------------------------------------------


Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of   y and My according to Annex 7   -
--------------------------------------------------------------
  y = Min(  y_ten,  y_com)
  y_ten = 3.1942884E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 707.00
      y = 0.31098033
     A = 0.0293404
     B = 0.015652
      with pt = 0.00696749
         pc = 0.00696749
         pv = 0.01521473
         N = 10489.234
         b = 250.00
          " = 0.06082037
  y_comp = 1.0098300E-005
 with fc* (12.3, (ACI 440)) = 33.16756
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        g = pt + pc + pv = 0.02914971
     rc = 40.00
     Ae/Ac = 0.17542991
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
   Ef = 64828.00
  Ec = 26999.444
   y = 0.30971595
  A = 0.02901552
  B = 0.01546131
    with Es = 200000.00
--------------------------------------------------------------
--------------------------------------------------------------


Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------
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: Immediate Occupancy (data interpolation between analysis steps 1 and 2)

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,  = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##########################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##########################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889

Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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  =  0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 =  Max(Mu1+ , Mu1-) = 5.9036E+008
   Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
   Mu2+ = 5.9036E+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- = 2.9749E+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 = 1.2706712E-005
Mu = 5.9036E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00

d' = 43.00
v = 0.00078635
   N = 9867.331
fc = 33.00
  co (5A.5, TBDY) = 0.002
Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.01138103$
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
      we ((5.4c), TBDY) = $ase^* sh,min*fywe/fce + Min(fx, fy) = 0.03881913$
   where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   -------------------------------------------------------------
      fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = $((bmax-2R)^2 + (hmax-2R)^2)/3 = 39233.333$
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
   -------------------------------------------------------------
      fy = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = $((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00$
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
   -------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
         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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
   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) = 0.00406911
         Lstir (Length of stirrups along Y) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
      -------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
         Lstir (Length of stirrups along X) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
      -------------------------------------------------------------
         s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY: cc = 0.00238888
      c = confinement factor = 1.03889

y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
  2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =    su (4.1) = 1.2706712E-005
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu1-
-----------------------------------------------------------------------

-----------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
-----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
    N = 9867.331
 fc = 33.00
  co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ---------------------------------------------------------------
     fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------
     fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------
     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     fu,f = 1055.00
     Ef = 64828.00
      u,f = 0.015
     ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

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

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY): cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
  v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
   2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
   v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
 u =   su (4.1) = 1.2514519E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------

---------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2706712E-005
Mu = 5.9036E+008
---------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 750.00
    hmax = 550.00
    From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
    effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
    s = 100.00
    fywe = 694.45
    fce = 33.00
    From ((5A5), TBDY), TBDY:  cc = 0.00238888
        c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
       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, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
   yv = 0.00140044
   shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
   suv = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
   2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
     2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
   u =   su (4.1) = 1.2706712E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Mu2-
------------------------------------------------------------------------

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 1.2514519E-005
Mu = 2.9749E+008
------------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 507.00
   d' = 43.00

v = 0.00235905
    N = 9867.331
fc = 33.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where  ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
        s = 100.00
      fywe = 694.45
      fce = 33.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00238888
        εc = confinement factor = 1.03889
  y1 = 0.00140044

sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
  v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775

Mu = MRc (4.14) = 2.9749E+008
  u =    su (4.1) = 1.2514519E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 21.4831
     Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
     f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and   =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
-------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254

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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 21.68208
     Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
     d = 440.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
     s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
     d = 200.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
     s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
     ψf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sinβ + cosβ is replaced with (cotθ +cotα)sina which is more a generalised expression,
  where θ is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, θ =45° and θ =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  α1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, α1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      εfe = 0.004, from (11.6a), ACI 440
        with εfu = 0.01
   From (11-11), ACI 440: Vs + Vf <= 419774.846
     bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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, γ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00
###############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
###############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
   Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
   Mu2+ = 5.7828E+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- = 5.7828E+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 = 9.2773974E-006
Mu = 5.7828E+008
-------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      εwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(εfx, εfy) = 0.03881913
    where εf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      εfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      εfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00

```
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
        s = 100.00
      fywe = 694.45
      fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c  = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
 b = 190.00
```

d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
 cc (5A.5, TBDY) = 0.00238888
   c = confinement factor = 1.03889
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
 2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
 v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu1-
-------------------------------------------------------------------------

-------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 9.2773974E-006
Mu = 5.7828E+008
-------------------------------------------------------------------------
with full section properties:
 b = 250.00
 d = 707.00
 d' = 43.00
 v = 0.00169171
   N = 9867.331
 fc = 33.00
  co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY:  cu = 0.01138103
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,   fy) = 0.03881913
   where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----------------------------------------------------------------
     fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
     bmax = 750.00
     hmax = 550.00
     From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
       bw = 250.00
     effective stress from (A.35), ff,e = 809.387
   ----------------------------------------------------------------
     fy = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
     bmax = 750.00
     hmax = 550.00
     From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
       bw = 250.00
     effective stress from (A.35), ff,e = 809.387
   ----------------------------------------------------------------
     R = 40.00

Effective FRP thickness, $t_f$ = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
   c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00

yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        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, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
      c = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
---------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
    co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

---------------------------------------------------------------
   $fx = 0.02979558$
  Expression ((15B.6), TBDY) is modified as $af = 1 - (\text{Unconfined area})/(\text{total area})$
  $af = 0.14946032$
  with Unconfined area $= ((bmax-2R)^2 + (hmax-2R)^2)/3 = 39233.333$
    $bmax = 750.00$
    $hmax = 550.00$
    From EC8 A4.4.3(6), $pf = 2tf/bw = 0.008128$
      $bw = 250.00$
    effective stress from (A.35), $ff,e = 809.387$
---------------------------------------------------------------
   $fy = 0.02979558$
  Expression ((15B.6), TBDY) is modified as $af = 1 - (\text{Unconfined area})/(\text{total area})$
  $af = 0.14946032$
  with Unconfined area $= ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00$
    $bmax = 750.00$
    $hmax = 550.00$
    From EC8 A4.4.3(6), $pf = 2tf/bw = 0.008128$
      $bw = 250.00$
    effective stress from (A.35), $ff,e = 809.387$
---------------------------------------------------------------
   $R = 40.00$
   Effective FRP thickness, $tf = NL*t*Cos(b1) = 1.016$
   $fu,f = 1055.00$
   $Ef = 64828.00$
    $u,f = 0.015$
   $ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065$
     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.
     $Aconf,max = 188100.00$ 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.
     $Aconf,min = 137025.00$ 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.
     $AnoConf = 97400.00$ is the unconfined core area which is equal to $bi2/6$ as defined at (A.2).
   $psh,min = Min(psh,x , psh,y) = 0.00406911$
  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)
    ---------------------------------------------------------------
    $psh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00406911$
     $Lstir$ (Length of stirrups along Y) $= 1760.00$
     $Astir$ (stirrups area) $= 78.53982$
     $Asec$ (section area) $= 262500.00$
    ---------------------------------------------------------------
    $psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591$
     $Lstir$ (Length of stirrups along X) $= 1360.00$
     $Astir$ (stirrups area) $= 78.53982$
     $Asec$ (section area) $= 262500.00$
    ---------------------------------------------------------------
    $s = 100.00$
    $fywe = 694.45$
    $fce = 33.00$
  From ((5.A5), TBDY, TBDY: $cc = 0.00238888$
    c = confinement factor = 1.03889
  $y1 = 0.00140044$
  $sh1 = 0.0044814$
 $ft1 = 466.8167$
$fy1 = 389.0139$
 $su1 = 0.00512$
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  $lo/lou,min = lb/ld = 0.30$
  $su1 = 0.4*esu1\_nominal ((5.5), TBDY) = 0.032$

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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
u = su (4.1) = 9.2773974E-006
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------

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


---------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
---------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ---------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ---------------------------------------------------------------
       fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ---------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        u,f = 0.015
     ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
     psh,min = Min(psh,x , psh,y) = 0.00406911
   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) = 0.00406911
          Lstir (Length of stirrups along Y) = 1760.00
          Astir (stirrups area) = 78.53982

Asec (section area) = 262500.00
        -----------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
            Lstir (Length of stirrups along X) = 1360.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
        -----------------------------------------------------------------
            s = 100.00
         fywe = 694.45
          fce = 33.00
     From ((5.A5), TBDY), TBDY:   cc = 0.00238888
           c = confinement factor = 1.03889
   y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
   y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
   yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00

d' = 13.00
fcc (5A.2, TBDY) = 34.2833
 cc (5A.5, TBDY) = 0.00238888
    c = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 680731.279
 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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514
 d = 0.8*h = 600.00
 Nu = 9867.331
 Ag = 187500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
 where:
 Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
 Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
 Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
 Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
 Vf ((11-3)-(11.4), ACI 440) = 372533.843
    f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
 where   is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:  1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 707.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
---------------------------------------------------------
---------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
    Mu = 106.0587
    Vu = 0.00038514
 d = 0.8*h = 600.00
 Nu = 9867.331
 Ag = 187500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
 where:
 Vs1 = 174534.321 is calculated for section web, with:
   d = 200.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs1 is multiplied by  Col1 = 1.00
   s/d = 0.50
 Vs2 = 523602.964 is calculated for section flange, with:
   d = 600.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs2 is multiplied by  Col2 = 1.00
   s/d = 0.16666667
 Vf ((11-3)-(11.4), ACI 440) = 372533.843
   f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
 where   is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:  1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 707.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
---------------------------------------------------------
---------------------------------------------------------
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,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
Bending Moment, M = -171486.715
Shear Force, V2 = 4666.206
Shear Force, V3 = -169.2694
Axial Force, F = -10489.234
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R = 1.0*  u = 0.0030636
  u =   y +   p = 0.0030636

-------------------------------------------------------------
 - Calculation of   y -
-------------------------------------------------------------
  y = (My*Ls/3)/Eleff = 0.0030636 ((4.29),Biskinis Phd))
   My = 4.1079E+008

```
   Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1013.099
   From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 4.5281E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 33.00
        N = 10489.234
     Ec*Ig = 1.5094E+014
```
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
--------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
--------------------------------------------------------------
```
   y = Min( y_ten, y_com)
   y_ten = 4.2686120E-006
   with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
      d = 507.00
       y = 0.28099731
      A = 0.01363818
      B = 0.00916195
       with pt = 0.00594858
            pc = 0.00218115
            pv = 0.00541982
            N = 10489.234
            b = 750.00
            " = 0.08481262
   y_comp = 1.5576756E-005
   with fc* (12.3, (ACI 440)) = 33.18002
      fc = 33.00
      fl = 0.56655003
      b = bmax = 750.00
      h = hmax = 550.00
      Ag = 262500.00
         g = pt + pc + pv = 0.01354954
         rc = 40.00
         Ae/Ac = 0.18847004
         Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.01
      Ef = 64828.00
      Ec = 26999.444
       y = 0.28009758
      A = 0.01348719
      B = 0.00907331
       with Es = 200000.00
CONFIRMATION:  y = 0.28045299 < t/d
```
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30

--------------------------------------------------------------
 - 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/VColOE = 0.78798666
   d = 507.00

s = 0.00
  t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
Av = 78.53982, is the area of every stirrup
Lstir = 1360.00, 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 = 10489.234
  Ag = 262500.00
  f'cE = 33.00
  fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01354954
  b = 750.00
  d = 507.00
  f'cE = 33.00
-------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)

-------------------------------------------------------------
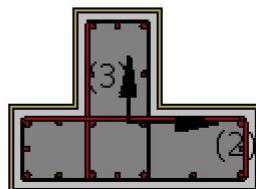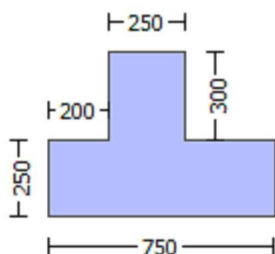
# Calculation No. 7

column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)



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

Constant Properties

```
-------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
###########################################################
Note: Especially for the calculation of  y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm =  33.00
New material: Steel Strength, fs = fsm = 555.56
###########################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -335583.449
Shear Force, Va = 169.2694
EDGE -B-
Bending Moment, Mb = -171486.715
Shear Force, Vb = -169.2694
BOTH EDGES
Axial Force, F = -10489.234
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 486187.797
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 486187.797
   VCol = 486187.797
```

knl = 1.00
    displacement_ductility_demand = 4.9595662E-006
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\psi$f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
$\lambda$ = 1 (normal-weight concrete)
fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 2.3025
    Mu = 171486.715
    Vu = 169.2694
d = 0.8*h = 440.00
Nu = 10489.234
Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
where:
Vs1 = 345575.192 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
Vs2 = 157079.633 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 267149.446
    $\psi$f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin $\beta$ + cos $\beta$ is replaced with (cot $\theta$ +cot$\alpha$)sin$\alpha$ which is more a generalised expression,
where $\theta$ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf($\theta$, $\alpha$), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, $\theta$ =45° and $\theta$ =-45° to take into consideration the cyclic seismic loading.
orientation 1:   $\alpha$1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, $\alpha$1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    $\varepsilon$fe = 0.004, from (11.6a), ACI 440
       with $\varepsilon$fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 365367.106
    bw = 250.00
------------------------------------------------------------

------------------------------------------------------------
displacement_ductility_demand is calculated as $\mu$ / $\mu$y

- Calculation of $\mu$ / $\mu$y for END B -
for rotation axis 2 and integ. section (b)
------------------------------------------------------------
From analysis, chord rotation $\theta$ = 1.5194137E-008
$\theta$y = (My*Ls/3)/EIeff = 0.0030636 ((4.29),Biskinis Phd))
My = 4.1079E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1013.099
From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 4.5281E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 33.00
       N = 10489.234
    Ec*Ig = 1.5094E+014
------------------------------------------------------------
------------------------------------------------------------

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of $y$ and My according to Annex 7   -
------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
------------------------------------------------------------

  y = Min( y_ten,  y_com)
  y_ten = 4.2686120E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 507.00
      y = 0.28099731
     A = 0.01363818
     B = 0.00916195
      with pt = 0.00594858
         pc = 0.00218115
         pv = 0.00541982
         N = 10489.234
         b = 750.00
          " = 0.08481262
  y_comp = 1.5576756E-005
  with fc* (12.3, (ACI 440)) = 33.18002
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
         g = pt + pc + pv = 0.01354954
        rc = 40.00
        Ae/Ac = 0.18847004
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      effective strain from (12.5) and (12.12), efe = 0.004
       fu = 0.01
     Ef = 64828.00
     Ec = 26999.444
      y = 0.28009758
     A = 0.01348719
     B = 0.00907331
      with Es = 200000.00
CONFIRMATION:  y = 0.28045299 < t/d
------------------------------------------------------------
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

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

## Calculation No. 8
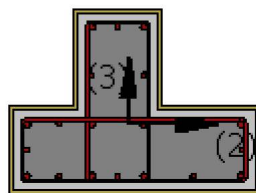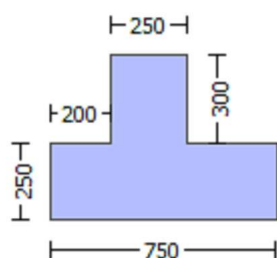
column C1, Floor 1

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

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,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00

Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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  =  0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 =  Max(Mu1+ , Mu1-) = 5.9036E+008
   Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
   Mu2+ = 5.9036E+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- = 2.9749E+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 = 1.2706712E-005
Mu = 5.9036E+008
----------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
       ----------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

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af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   $bi2/6$ as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00238888
    c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
  2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =   su (4.1) = 1.2706712E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu1-
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---------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2514519E-005
Mu = 2.9749E+008
---------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
    N = 9867.331
  fc = 33.00
  co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591

Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

---------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
b = 190.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888

c  = confinement factor = 1.03889
    ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    ω2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    ωv = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  φu = φsu (4.1) = 1.2514519E-005
 ------------------------------------------------------------

Calculation of ratio lb/ld
 ------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
 ----------------------------------------------------------------------
 ----------------------------------------------------------------------
 ----------------------------------------------------------------------
Calculation of Mu2+
 ----------------------------------------------------------------------

 ----------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.2706712E-005
Mu = 5.9036E+008
 ----------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
     N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu:  εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01138103
       ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(αfx, αfy) = 0.03881913
     where αf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
       -------------------------------------------------------------
       αfx = 0.02979558
       Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
       αf = 0.14946032
       with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
          bmax = 750.00
          hmax = 550.00
          From EC8 A 4.4.3(6), ρf = 2tf/bw = 0.008128
             bw = 250.00
          effective stress from (A.35), ff,e = 809.387
       -------------------------------------------------------------
       αfy = 0.02979558
       Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
       αf = 0.14946032
       with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
          bmax = 750.00
          hmax = 550.00
          From EC8 A 4.4.3(6), ρf = 2tf/bw = 0.008128
             bw = 250.00
          effective stress from (A.35), ff,e = 809.387
       -------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        εu,f = 0.015

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065

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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911

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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

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

    s = 100.00
    fywe = 694.45
    fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139

suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
  2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
    c = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u = su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
   N = 9867.331
  fc = 33.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
   where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----------------------------------------------------------------
    fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032

with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
  bmax = 750.00
  hmax = 550.00
  From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
  effective stress from (A.35), ff,e = 809.387
--------------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
  bmax = 750.00
  hmax = 550.00
  From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
  effective stress from (A.35), ff,e = 809.387
--------------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
--------------------------------------------------------------------
  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
--------------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.

with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
b = 190.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
 cc (5A.5, TBDY) = 0.00238888
  c  = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
u =  su (4.1) = 1.2514519E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
--------------------------------------------------------------------

Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ᵠf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.4831
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    ᵠf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where    is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    ᵋfe = 0.004, from (11.6a), ACI 440
      with  ᵋfu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ᵠf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.68208
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
#############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889

Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
   Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
   Mu2+ = 5.7828E+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- = 5.7828E+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 = 9.2773974E-006
Mu = 5.7828E+008
------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00

$d' = 43.00$

$v = 0.00169171$

$N = 9867.331$

$fc = 33.00$

$\varepsilon co$ (5A.5, TBDY) = 0.002

Final value of $\varepsilon cu$: $\varepsilon cu^* = shear\_factor * Max(\varepsilon cu, \varepsilon cc) = 0.01138103$

   The Shear_factor is considered equal to 1 (pure moment strength)

   From (5.4b), TBDY: $\varepsilon cu = 0.01138103$

     $\omega we$ ((5.4c), TBDY) $= \alpha se* \rho sh,min*fywe/fce + Min(\omega fx, \omega fy) = 0.03881913$

   where $\omega f = \alpha f*\rho f*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

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

    $\omega fx = 0.02979558$

   Expression ((15B.6), TBDY) is modified as $\alpha f = 1 - (Unconfined\ area)/(total\ area)$

   $\alpha f = 0.14946032$

   with Unconfined area $= ((bmax-2R)^2 + (hmax-2R)^2)/3 = 39233.333$

    $bmax = 750.00$

    $hmax = 550.00$

    From EC8 A.4.4.3(6), $\rho f = 2tf/bw = 0.008128$

     $bw = 250.00$

    effective stress from (A.35), $ff,e = 809.387$

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

    $\omega fy = 0.02979558$

   Expression ((15B.6), TBDY) is modified as $\alpha f = 1 - (Unconfined\ area)/(total\ area)$

   $\alpha f = 0.14946032$

   with Unconfined area $= ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00$

    $bmax = 750.00$

    $hmax = 550.00$

    From EC8 A.4.4.3(6), $\rho f = 2tf/bw = 0.008128$

     $bw = 250.00$

    effective stress from (A.35), $ff,e = 809.387$

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

    $R = 40.00$

    Effective FRP thickness, $tf = NL*t*Cos(b1) = 1.016$

    $fu,f = 1055.00$

    $Ef = 64828.00$

    $\varepsilon u,f = 0.015$

    $\alpha se = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065$

     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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to $bi2/6$ as defined at (A.2).

    $\rho sh,min = Min(\rho sh,x, \rho sh,y) = 0.00406911$

  Expression ((5.4d), TBDY) for $\rho sh,min$ 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) $= Lstir*Astir/(Asec*s) = 0.00406911$

     Lstir (Length of stirrups along Y) = 1760.00

     Astir (stirrups area) = 78.53982

     Asec (section area) = 262500.00

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

    $\rho sh,y$ ((5.4d), TBDY) $= Lstir*Astir/(Asec*s) = 0.00526591$

     Lstir (Length of stirrups along X) = 1360.00

     Astir (stirrups area) = 78.53982

     Asec (section area) = 262500.00

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

     $s = 100.00$

    $fywe = 694.45$

    $fce = 33.00$

   From ((5.A5), TBDY), TBDY: $\varepsilon cc = 0.00238888$

    $\lambda c$ = confinement factor = 1.03889

y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
        c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------
------------------------------------------------------------------
------------------------------------------------------------------
Calculation of Mu1-
------------------------------------------------------------------

------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ---------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
--------------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
--------------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY:  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------

----------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
     N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+ Min(  fx,   fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     -----------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
           bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     -----------------------------------------------------------------
       fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

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af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
     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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
    s = 100.00
    fywe = 694.45
    fce = 33.00
  From ((5.A5), TBDY:  cc = 0.00238888
    c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
        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, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
    yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        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, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00

v = 0.00169171

N = 9867.331

fc = 33.00

co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103

The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: cu = 0.01138103

we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913

where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

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

fx = 0.02979558

Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032

with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333

bmax = 750.00

hmax = 550.00

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128

bw = 250.00

effective stress from (A.35), ff,e = 809.387

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

fy = 0.02979558

Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032

with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00

bmax = 750.00

hmax = 550.00

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128

bw = 250.00

effective stress from (A.35), ff,e = 809.387

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

R = 40.00

Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016

fu,f = 1055.00

Ef = 64828.00

u,f = 0.015

ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065

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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00406911

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) = 0.00406911

Lstir (Length of stirrups along Y) = 1760.00

Astir (stirrups area) = 78.53982

Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591

Lstir (Length of stirrups along X) = 1360.00

Astir (stirrups area) = 78.53982

Asec (section area) = 262500.00

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

s = 100.00

fywe = 694.45

fce = 33.00

From ((5.A5), TBDY), TBDY: cc = 0.00238888

c = confinement factor = 1.03889

y1 = 0.00140044

sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
 2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
 v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
     c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748

Mu = MRc (4.14) = 5.7828E+008
  θu = θsu (4.1) = 9.2773974E-006
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by αCol1 = 1.00
    s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by αCol2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
    ψf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sinβ + cosβ is replaced with (cotθ+cota)sina which is more a generalised expression,
  where θ is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
  orientation 1: α1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, α1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    εfe = 0.004, from (11.6a), ACI 440
     with εfu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
-------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279

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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
    Mu = 106.0587
    Vu = 0.00038514
 d = 0.8*h = 600.00
 Nu = 9867.331
 Ag = 187500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
 where:
 Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
 Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.50
 Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
 Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.16666667
 Vf ((11-3)-(11.4), ACI 440) = 372533.843
    ψf = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sinβ + cosβ is replaced with (cotθ +cota)sina which is more a generalised expression,
 where θ is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
 orientation 1:  α1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45, α1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 707.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    εfe = 0.004, from (11.6a), ACI 440
       with εfu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
    bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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, κ = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56

Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
Bending Moment, M = 203483.692
Shear Force, V2 = 4666.206
Shear Force, V3 = -169.2694
Axial Force, F = -10489.234
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
------------------------------------------------------------
------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity  $\theta$u,R = 1.0* $\theta$u = 0.000522
 $\theta$u = $\theta$y + $\theta$p = 0.000522

------------------------------------------------------------
 - Calculation of $\theta$y -
------------------------------------------------------------
 $\theta$y = (My*Ls/3)/EIeff = 0.000522 ((4.29),Biskinis Phd))
  My = 3.9379E+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 = 7.5439E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 33.00
       N = 10489.234
    Ec*Ig = 2.5146E+014
------------------------------------------------------------
------------------------------------------------------------

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of $\theta$y and My according to Annex 7  -

---------------------------------------------------------------
 y = Min( y_ten, y_com)
 y_ten = 3.1942884E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 707.00
     y = 0.31098033
    A = 0.0293404
    B = 0.015652
     with pt = 0.00696749
        pc = 0.00696749
        pv = 0.01521473
        N = 10489.234
        b = 250.00
        " = 0.06082037
 y_comp = 1.0098300E-005
 with fc* (12.3, (ACI 440)) = 33.16756
    fc = 33.00
    fl = 0.56655003
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
       g = pt + pc + pv = 0.02914971
       rc = 40.00
       Ae/Ac = 0.17542991
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
    Ef = 64828.00
    Ec = 26999.444
     y = 0.30971595
    A = 0.02901552
    B = 0.01546131
     with Es = 200000.00
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30


---------------------------------------------------------------
 - 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 = 0.56632982
   d = 707.00
   s = 0.00
    t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
   Av = 78.53982, is the area of every stirrup
   Lstir = 1760.00, 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 = 10489.234
    Ag = 262500.00
    f'cE = 33.00
    fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
   b = 250.00
   d = 707.00
   f'cE = 33.00
---------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

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

---

## Calculation No. 9
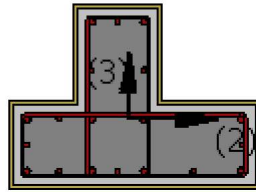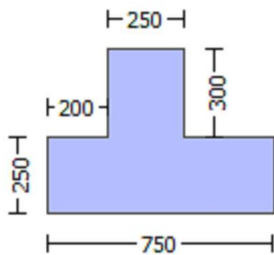
column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)



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

Constant Properties
------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
###########################################################
Note: Especially for the calculation of  y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm =  33.00
New material: Steel Strength, fs = fsm = 555.56
###########################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00

Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.7126E+007
Shear Force, Va = -5625.628
EDGE -B-
Bending Moment, Mb = 245343.925
Shear Force, Vb = 5625.628
BOTH EDGES
Axial Force, F = -10617.103
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 592701.343
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 592701.343
   VCol = 592701.343
   knl = 1.00
      displacement_ductility_demand = 0.01757212
-------------------------------------------------------------
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' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 1.7126E+007
     Vu = 5625.628
  d = 0.8*h = 600.00
  Nu = 10617.103
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 628318.531
  where:
  Vs1 = 157079.633 is calculated for section web, with:
     d = 200.00
     Av = 157079.633

```
        fy = 500.00
        s = 100.00
    Vs1 is multiplied by   Col1 = 1.00
        s/d = 0.50
    Vs2 = 471238.898 is calculated for section flange, with:
        d = 600.00
        Av = 157079.633
        fy = 500.00
        s = 100.00
    Vs2 is multiplied by   Col2 = 1.00
        s/d = 0.16666667
    Vf ((11-3)-(11.4), ACI 440) = 372533.843
        f = 0.95, for fully-wrapped sections
    wf/sf = 1 (FRP strips adjacent to one another).
    In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
    where   is the angle of the crack direction (see KANEPE).
    This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
    as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
    orientation 1:   1 = b1 + 90° = 90.00
    Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
    total thickness per orientation, tf1 = NL*t/NoDir = 1.016
    dfv = d (figure 11.2, ACI 440) = 707.00
    ffe ((11-5), ACI 440) = 259.312
        Ef = 64828.00
         fe = 0.004, from (11.6a), ACI 440
          with  fu = 0.01
    From (11-11), ACI 440: Vs + Vf <= 498227.872
        bw = 250.00
---------------------------------------------------------


---------------------------------------------------------
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    = 9.3088220E-005
  y = (My*Ls/3)/Eleff = 0.00529749 ((4.29),Biskinis Phd))
  My = 3.9382E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3044.273
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 7.5439E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 33.00
        N = 10617.103
     Ec*Ig = 2.5146E+014
---------------------------------------------------------
---------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------
Calculation of  y and My according to Annex 7  -
---------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 3.1943925E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 707.00
      y = 0.31100278
     A = 0.02934273
     B = 0.01565432
      with pt = 0.00696749
         pc = 0.00696749
         pv = 0.01521473
         N = 10617.103
         b = 250.00
          " = 0.06082037
  y_comp = 1.0098067E-005
```

with fc* (12.3, (ACI 440)) = 33.16756
    fc = 33.00
    fl = 0.56655003
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
        g = pt + pc + pv = 0.02914971
    rc = 40.00
    Ae/Ac = 0.17542991
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.01
  Ef = 64828.00
  Ec = 26999.444
    y = 0.30972311
  A = 0.02901389
  B = 0.01546131
  with Es = 200000.00

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

Calculation of ratio lb/ld
---------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)

---------------------------------------------------------
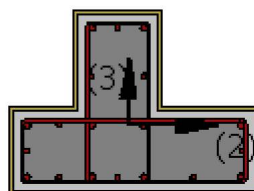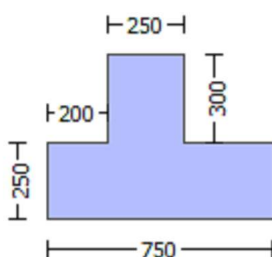
# Calculation No. 10

column C1, Floor 1

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

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,    = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------


Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.9036E+008
  Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
  Mu2+ = 5.9036E+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- = 2.9749E+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 $\phi u$ according to 4.1, Biskinis/Fardis 2013:
  $\phi u$ = 1.2706712E-005
Mu = 5.9036E+008
-------------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   $\epsilon co$ (5A.5, TBDY) = 0.002
  Final value of $\epsilon cu$: $\epsilon cu^*$ = shear_factor * Max($\epsilon cu$, $\epsilon cc$) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: $\epsilon cu$ = 0.01138103
      $\omega we$ ((5.4c), TBDY) = $\alpha se^* \rho sh,min^*fywe/fce+Min(\omega fx, \omega fy)$ = 0.03881913
    where $\omega f = \alpha f^* \rho f^*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -----------------------------------------------------------------------
      $\omega fx$ = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      $\omega fy$ = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       $\epsilon u,f$ = 0.015
      $\alpha se$ = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

--------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

--------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
 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, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
  c = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =  su (4.1) = 1.2706712E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu1-
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
----------------------------------------------------------------------------
with full section properties:
 b = 250.00
 d = 507.00
 d' = 43.00
 v = 0.00235905
   N = 9867.331
 fc = 33.00
  co (5A.5, TBDY) = 0.002
 Final value of  cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY:  cu = 0.01138103
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
   where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   --------------------------------------------------------------------
    fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
    bmax = 750.00
    hmax = 550.00

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
effective stress from (A.35), ff,e = 809.387
----------------------------------------------------------------

fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
    bmax = 750.00
    hmax = 550.00
From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
effective stress from (A.35), ff,e = 809.387
----------------------------------------------------------------

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----------------------------------------------------------------

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----------------------------------------------------------------

s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044

sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
  v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
  2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
  v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
 u =   su (4.1) = 1.2514519E-005
---------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2706712E-005

Mu = 5.9036E+008

---

with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

    ---

      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387

    ---

      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387

    ---

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
         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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00

    ---

      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00

    ---

```
              s = 100.00
           fywe = 694.45
           fce  = 33.00
       From ((5.A5), TBDY), TBDY:  cc = 0.00238888
            c = confinement factor = 1.03889
     y1 = 0.00140044
    sh1 = 0.0044814
   ft1 = 466.8167
   fy1 = 389.0139
    su1 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       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, ASCE41-17.
       with fs1 = fs = 389.0139
       with Es1 = Es = 200000.00
     y2 = 0.00140044
    sh2 = 0.0044814
   ft2 = 466.8167
   fy2 = 389.0139
    su2 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
       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, ASCE41-17.
       with fs2 = fs = 389.0139
       with Es2 = Es = 200000.00
     yv = 0.00140044
    shv = 0.0044814
   ftv = 466.8167
   fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       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, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
     2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
     v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
 and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
       c = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
     2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
```

Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =   su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
   N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     --------------------------------------------------------------------
        fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
           bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     --------------------------------------------------------------------
        fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
           bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     --------------------------------------------------------------------
        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
           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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

-----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

-----------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY, TBDY:  cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.30
 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, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c = confinement factor = 1.03889
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
 2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
 v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
 u =  su (4.1) = 1.2514519E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 499463.254
 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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
  Mu = 21.4831
  Vu = 6.0494360E-005
 d = 0.8*h = 440.00
 Nu = 9867.331
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
 where:
 Vs1 = 383975.507 is calculated for section web, with:
  d = 440.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
 Vs1 is multiplied by  Col1 = 1.00
  s/d = 0.22727273
 Vs2 = 174534.321 is calculated for section flange, with:

d = 200.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by Col2 = 1.00
s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 267149.446
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinβ + cosβ is replaced with (cotθ + cotα)sinα which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ = 45° and θ = -45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = β1 + 90° = 90.00
Vf = Min(|Vf(45, α1)|, |Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
εfe = 0.004, from (11.6a), ACI 440
with εfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 419774.846
bw = 250.00
-------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
VCol0 = 499463.254
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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
Mu = 21.68208
Vu = 6.0494360E-005
d = 0.8*h = 440.00
Nu = 9867.331
Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 383975.507 is calculated for section web, with:
d = 440.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs1 is multiplied by Col1 = 1.00
s/d = 0.22727273
Vs2 = 174534.321 is calculated for section flange, with:
d = 200.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by Col2 = 1.00
s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 267149.446
ψf = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinβ + cosβ is replaced with (cotθ + cotα)sinα which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ = 45° and θ = -45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = β1 + 90° = 90.00
Vf = Min(|Vf(45, α1)|, |Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 507.00
    ffe ((11-5), ACI 440) = 259.312
        Ef = 64828.00
        fe = 0.004, from (11.6a), ACI 440
            with   fu = 0.01
    From (11-11), ACI 440: Vs + Vf < = 419774.846
        bw = 250.00
------------------------------------------------------------
------------------------------------------------------------
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,    = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
----------------------------------------------------------

Stepwise Properties
----------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-

Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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  =  0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 =  Max(Mu1+ , Mu1-) = 5.7828E+008
   Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
   Mu2+ = 5.7828E+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- = 5.7828E+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   $\varphi$u according to 4.1, Biskinis/Fardis 2013:
 $\varphi$u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   $\varepsilon$co (5A.5, TBDY) = 0.002
  Final value of  $\varepsilon$cu:  $\varepsilon$cu* = shear_factor * Max( $\varepsilon$cu,  $\varepsilon$cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  $\varepsilon$cu = 0.01138103
       $\omega$we ((5.4c), TBDY) = $\alpha$se* $\rho$sh,min*fywe/fce+Min( $\omega$fx,  $\omega$fy) = 0.03881913
     where   $\omega$f = $\alpha$f*$\rho$f*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       $\omega$fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as $\alpha$f = 1 - (Unconfined area)/(total area)
     $\alpha$f = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A.4.4.3(6), $\rho$f = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ----------------------------------------------------------------
       $\omega$fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as $\alpha$f = 1 - (Unconfined area)/(total area)
     $\alpha$f = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 750.00

hmax = 550.00
From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
effective stress from (A.35), ff,e = 809.387
------------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
------------------------------------------------------------------
 s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu1-
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00

co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -----------------------------------------------------------------
    fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
    fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
      Lstir (Length of stirrups along Y) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    -----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
      Lstir (Length of stirrups along X) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    -----------------------------------------------------------------
      s = 100.00
    fywe = 694.45
    fce = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139

su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
  2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
    c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
--------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------------


----------------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -----------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    -----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911

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) = 0.00406911
         Lstir (Length of stirrups along Y) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00

     --------------------------------------------------------------
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
         Lstir (Length of stirrups along X) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00

     --------------------------------------------------------------
       s = 100.00
     fywe = 694.45
     fce = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00238888
       c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
```

1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
         2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
         v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
       c  = confinement factor = 1.03889
       1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
       2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
       v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =    su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------


--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 9.2773974E-006
Mu = 5.7828E+008
--------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 707.00
   d' = 43.00
   v = 0.00169171
      N = 9867.331
   fc = 33.00
     co (5A.5, TBDY) = 0.002
   Final value of   cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01138103
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,  fy) = 0.03881913
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ------------------------------------------------------------
        fx = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
         bmax = 750.00
         hmax = 550.00
         From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
            bw = 250.00
         effective stress from (A.35), ff,e = 809.387

      ------------------------------------------------------------
        fy = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 750.00
         hmax = 550.00

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
      bw = 250.00
   effective stress from (A.35), ff,e = 809.387
   ---------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
   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) = 0.00406911
      Lstir (Length of stirrups along Y) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
   ---------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
      Lstir (Length of stirrups along X) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
   ---------------------------------------------------------------
       s = 100.00
      fywe = 694.45
      fce  = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00238888
       c  = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
   yv = 0.00140044
   shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514

d = 0.8*h = 600.00
Nu = 9867.331
Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
where:
Vs1 = 174534.321 is calculated for section web, with:
   d = 200.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
Vs1 is multiplied by   Col1 = 1.00
   s/d = 0.50
Vs2 = 523602.964 is calculated for section flange, with:
   d = 600.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
Vs2 is multiplied by   Col2 = 1.00
   s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 372533.843
   f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 572420.244
   bw = 250.00
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 106.0587
     Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 555.56

```
     s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
     s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
 where    is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:   1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 707.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 572420.244
    bw = 250.00
```
----------------------------------------------------------
----------------------------------------------------------
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,    = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

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

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = -404578.584
Shear Force, V2 = -5625.628
Shear Force, V3 = 204.073
Axial Force, F = -10617.103
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
----------------------------------------------------------------
----------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   $\theta_u,R$ = 1.0* $\theta_u$ = 0.04799549
 $\theta_u$ = $\theta_y$ + $\theta_p$ = 0.04799549


---------------------------------------------------------------
 - Calculation of  $\theta_y$ -
---------------------------------------------------------------
 $\theta_y$ = (My*Ls/3)/Eleff = 0.00599549 ((4.29),Biskinis Phd))
  My = 4.1082E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1982.519
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 4.5281E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 33.00
        N = 10617.103
     Ec*Ig = 1.5094E+014
----------------------------------------------------------------
----------------------------------------------------------------

Calculation of Yielding Moment My
----------------------------------------------------------------
Calculation of  $\theta_y$ and My according to Annex 7   -
----------------------------------------------------------------
Assuming neutral axis within flange ( $\xi_y$ < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
----------------------------------------------------------------
  $\phi_y$ = Min( $\phi_y$_ten,  $\phi_y$_com)
  $\phi_y$_ten = 4.2687014E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 507.00
     $\xi_y$ = 0.28101237
    A = 0.01363926
    B = 0.00916303
     with pt = 0.00594858
        pc = 0.00218115
        pv = 0.00541982
        N = 10617.103
        b = 750.00
         " = 0.08481262
  $\phi_y$_comp = 1.5576525E-005
 with fc* (12.3, (ACI 440)) = 33.18002
    fc = 33.00
    fl = 0.56655003
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00

153

g = pt + pc + pv = 0.01354954
rc = 40.00
Ae/Ac = 0.18847004
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
effective strain from (12.5) and (12.12), efe = 0.004
fu = 0.01
Ef = 64828.00
Ec = 26999.444
y = 0.28010173
A = 0.01348643
B = 0.00907331
with Es = 200000.00
CONFIRMATION:  y = 0.28046145 < t/d
---------------------------------------------------------
---------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30


---------------------------------------------------------
 - Calculation of  p -
---------------------------------------------------------
From table 10-8:  p = 0.042
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 0.78798666
   d = 507.00
   s = 0.00
   t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
   Av = 78.53982, is the area of every stirrup
   Lstir = 1360.00, 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 = 10617.103
     Ag = 262500.00
     f'cE = 33.00
     fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01354954
   b = 750.00
   d = 507.00
     f'cE = 33.00
---------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (a)


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

## Calculation No. 11
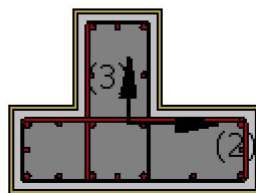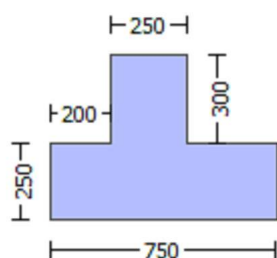
column C1, Floor 1

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

Analysis: Uniform + X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)



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

Constant Properties
------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016

Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -404578.584
Shear Force, Va = 204.073
EDGE -B-
Bending Moment, Mb = -206750.678
Shear Force, Vb = -204.073
BOTH EDGES
Axial Force, F = -10617.103
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
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 434927.047
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 434927.047
   VCol = 434927.047
   knl = 1.00
      displacement_ductility_demand = 0.00378804
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ᵩf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    ᵧ = 1 (normal-weight concrete)
   fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 404578.584
      Vu = 204.073
   d = 0.8*h = 440.00
   Nu = 10617.103
   Ag = 137500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
   where:
   Vs1 = 345575.192 is calculated for section web, with:
      d = 440.00
      Av = 157079.633
      fy = 500.00
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.22727273
   Vs2 = 157079.633 is calculated for section flange, with:
      d = 200.00
      Av = 157079.633
      fy = 500.00
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 267149.446
      ᵩf = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).

In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
     with fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 365367.106
   bw = 250.00
------------------------------------------------------------

------------------------------------------------------------
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 = 2.2711187E-005
 y = (My*Ls/3)/EIeff = 0.00599549 ((4.29),Biskinis Phd))
 My = 4.1082E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1982.519
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 4.5281E+013
    factor = 0.30
      Ag = 262500.00
      fc' = 33.00
      N = 10617.103
    Ec*Ig = 1.5094E+014
------------------------------------------------------------
------------------------------------------------------------

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of y and My according to Annex 7 -
------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
------------------------------------------------------------
 y = Min( y_ten, y_com)
 y_ten = 4.2687014E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 507.00
     y = 0.28101237
    A = 0.01363926
    B = 0.00916303
     with pt = 0.00594858
        pc = 0.00218115
        pv = 0.00541982
        N = 10617.103
        b = 750.00
         " = 0.08481262
  y_comp = 1.5576525E-005
 with fc* (12.3, (ACI 440)) = 33.18002
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        g = pt + pc + pv = 0.01354954
        rc = 40.00
        Ae/Ac = 0.18847004

Effective FRP thickness, $t_f = NL*t*Cos(b1) = 1.016$
effective strain from (12.5) and (12.12), $e_{fe} = 0.004$
$f_u = 0.01$
$E_f = 64828.00$
$E_c = 26999.444$
$y = 0.28010173$
$A = 0.01348643$
$B = 0.00907331$
with $E_s = 200000.00$
CONFIRMATION:  $y = 0.28046145 < t/d$

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

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------
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

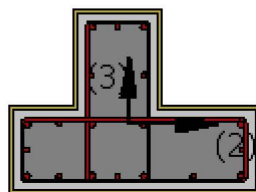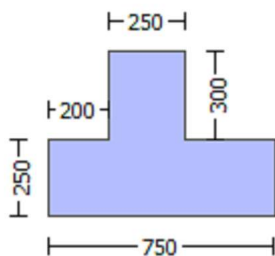Limit State: Collapse Prevention (data interpolation between analysis steps 1 and 2)

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, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.9036E+008
   Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008

  Mu2+ = 5.9036E+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- = 2.9749E+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 $\phi_u$ according to 4.1, Biskinis/Fardis 2013:

  $\phi_u$ = 1.2706712E-005

Mu = 5.9036E+008

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

with full section properties:

  b = 750.00

  d = 507.00

  d' = 43.00

  v = 0.00078635

   N = 9867.331

  fc = 33.00

   $\varepsilon_{co}$ (5A.5, TBDY) = 0.002

  Final value of $\varepsilon_{cu}$: $\varepsilon_{cu}^*$ = shear_factor * Max($\varepsilon_{cu}$, $\varepsilon_{cc}$) = 0.01138103

    The Shear_factor is considered equal to 1 (pure moment strength)

    From (5.4b), TBDY: $\varepsilon_{cu}$ = 0.01138103

      $\omega_{we}$ ((5.4c), TBDY) = $\alpha_{se}^*\rho_{sh,min}$*fywe/fce+Min($\Delta\omega_{fx}$, $\Delta\omega_{fy}$) = 0.03881913

    where $\Delta\omega_f$ = $\alpha_f$*$\rho_f$*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

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

     $\Delta\omega_{fx}$ = 0.02979558

    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

    af = 0.14946032

    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333

      bmax = 750.00

      hmax = 550.00

      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128

        bw = 250.00

      effective stress from (A.35), ff,e = 809.387

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

     $\Delta\omega_{fy}$ = 0.02979558

    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

    af = 0.14946032

    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00

      bmax = 750.00

      hmax = 550.00

      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128

        bw = 250.00

      effective stress from (A.35), ff,e = 809.387

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

     R = 40.00

     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016

     fu,f = 1055.00

     Ef = 64828.00

      $\varepsilon_{u,f}$ = 0.015

     $\alpha_{se}$ = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065

      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to $\Sigma bi^2/6$ as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
  Lstir (Length of stirrups along Y) = 1760.00
  Astir (stirrups area) = 78.53982
  Asec (section area) = 262500.00

-------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
  Lstir (Length of stirrups along X) = 1360.00
  Astir (stirrups area) = 78.53982
  Asec (section area) = 262500.00

-------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fsv = fs = 389.0139

with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
     2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
     v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
        c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
     2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
 v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
   u =   su (4.1) = 1.2706712E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------


--------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 1.2514519E-005
Mu = 2.9749E+008
--------------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 507.00
   d' = 43.00
   v = 0.00235905
     N = 9867.331
   fc = 33.00
     co (5A.5, TBDY) = 0.002
   Final value of   cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
       The Shear_factor is considered equal to 1 (pure moment strength)
       From (5.4b), TBDY:  cu = 0.01138103
         we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
       where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
       ----------------------------------------------------------------
         fx = 0.02979558
       Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
       af = 0.14946032
       with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
          bmax = 750.00
          hmax = 550.00
          From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
             bw = 250.00
          effective stress from (A.35), ff,e = 809.387
       ----------------------------------------------------------------
         fy = 0.02979558
       Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
       af = 0.14946032
       with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
          bmax = 750.00

hmax = 550.00
        From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ---------------------------------------------------------------
        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
           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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00406911
     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) = 0.00406911
           Lstir (Length of stirrups along Y) = 1760.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 262500.00
     ---------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
           Lstir (Length of stirrups along X) = 1360.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 262500.00
     ---------------------------------------------------------------
         s = 100.00
        fywe = 694.45
        fce = 33.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00238888
         c = confinement factor = 1.03889
   y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
   y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
  v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
  2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
  v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
 u =  su (4.1) = 1.2514519E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2+
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2706712E-005
Mu = 5.9036E+008
--------------------------------------------------------------------
with full section properties:
 b = 750.00
 d = 507.00
 d' = 43.00
 v = 0.00078635
   N = 9867.331
 fc = 33.00

co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
   where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----------------------------------------------------------------
   fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
     bmax = 750.00
     hmax = 550.00
     From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
       bw = 250.00
     effective stress from (A.35), ff,e = 809.387
----------------------------------------------------------------
   fy = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
     bmax = 750.00
     hmax = 550.00
     From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
       bw = 250.00
     effective stress from (A.35), ff,e = 809.387
----------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
   u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
     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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
     Lstir (Length of stirrups along Y) = 1760.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 262500.00
----------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
     Lstir (Length of stirrups along X) = 1360.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 262500.00
----------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00238888
    c = confinement factor = 1.03889
  y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139

su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
 2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
 v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =   su (4.1) = 1.2706712E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Mu2-
---------------------------------------------------------------------------

---------------------------------------------------------------------------
Calculation of ultimate curvature  φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.2514519E-005
Mu = 2.9749E+008
---------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  ν = 0.00235905
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of  εcu:  εcu* = shear_factor * Max( εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min( ωfx,  ωfy) = 0.03881913
    where  ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911

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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

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

$psh,y$ ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

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

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
   c = confinement factor = 1.03889
$y1$ = 0.00140044
$sh1$ = 0.0044814
$ft1$ = 466.8167
$fy1$ = 389.0139
$su1$ = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   $su1$ = 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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
$y2$ = 0.00140044
$sh2$ = 0.0044814
$ft2$ = 466.8167
$fy2$ = 389.0139
$su2$ = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   $su2$ = 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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
$yv$ = 0.00140044
$shv$ = 0.0044814
$ftv$ = 466.8167
$fyv$ = 389.0139
$suv$ = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   $suv$ = 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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00

```
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
    v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  u =   su (4.1) = 1.2514519E-005
------------------------------------------------------------


Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
-----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 499463.254
   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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 21.4831
     Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
```

In (11.3) sin $\alpha$ + cos $\alpha$ is replaced with (cot $\theta$+cota)sina which is more a generalised expression,
where $\theta$ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, $\theta$ = 45° and $\theta$ = -45° to take into consideration the cyclic seismic loading.
orientation 1: $\alpha_1$ = b1 + 90° = 90.00
Vf = Min(|Vf(45, $\alpha_1$)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
      $\varepsilon$fe = 0.004, from (11.6a), ACI 440
        with $\varepsilon$fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 419774.846
    bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ $\Psi$f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    $\lambda$ = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.68208
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by $\eta$Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by $\eta$Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    $\Psi$f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin $\alpha$ + cos $\alpha$ is replaced with (cot $\theta$+cota)sina which is more a generalised expression,
  where $\theta$ is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, $\theta$ = 45° and $\theta$ = -45° to take into consideration the cyclic seismic loading.
  orientation 1: $\alpha_1$ = b1 + 90° = 90.00
  Vf = Min(|Vf(45, $\alpha_1$)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
      $\varepsilon$fe = 0.004, from (11.6a), ACI 440
        with $\varepsilon$fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 419774.846
    bw = 250.00
------------------------------------------------------------
------------------------------------------------------------

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,    = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
  Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
  Mu2+ = 5.7828E+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- = 5.7828E+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   $\phi u$ according to 4.1, Biskinis/Fardis 2013:
  $\phi u$ = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
     N = 9867.331
  fc = 33.00
    $\epsilon co$ (5A.5, TBDY) = 0.002
  Final value of  $\epsilon cu$:  $\epsilon cu$* = shear_factor * Max( $\epsilon cu$, $\epsilon cc$) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: $\epsilon cu$ = 0.01138103
       $\omega we$ ((5.4c), TBDY) = $\alpha se$* $\rho sh,min$*fywe/fce+Min( $\omega fx$,  $\omega fy$) = 0.03881913
     where  $\omega f = \alpha f*\rho f*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
       ----------------------------------------------------------------
       $\omega fx$ = 0.02979558
       Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
       af = 0.14946032
       with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
          bmax = 750.00
          hmax = 550.00
          From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
            bw = 250.00
          effective stress from (A.35), ff,e = 809.387
       ----------------------------------------------------------------
       $\omega fy$ = 0.02979558
       Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
       af = 0.14946032
       with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
          bmax = 750.00
          hmax = 550.00
          From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
            bw = 250.00
          effective stress from (A.35), ff,e = 809.387
       ----------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00

u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    --------------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    --------------------------------------------------------------------
        s = 100.00
     fywe = 694.45
     fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c  = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167

fyv = 389.0139
       suv = 0.00512
         using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
         and also multiplied by the shear_factor according to 15.7.1.4, with
         Shear_factor = 1.00
         lo/lou,min = lb/ld = 0.30
           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, ASCE41-17.
           with fsv = fs = 389.0139
           with Esv = Es = 200000.00
       1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
       2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
       v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
       c = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
     2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
     v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
   u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu1-
-----------------------------------------------------------------------

-----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 9.2773974E-006
Mu = 5.7828E+008
-----------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 707.00
   d' = 43.00
   v = 0.00169171
     N = 9867.331
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
       -------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 39233.333
    bmax = 750.00
    hmax = 550.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
    effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
    fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 0.00
    bmax = 750.00
    hmax = 550.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
    effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -------------------------------------------------------------
        s = 100.00
    fywe = 694.45
    fce = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c = confinement factor = 1.03889
  y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
  c = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
u =   su (4.1) = 9.2773974E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu2+
-----------------------------------------------------------------------

```
-------------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
-------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ------------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
```

```
          Lstir (Length of stirrups along X) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 262500.00

     ----------------------------------------------------------------
          s = 100.00
       fywe = 694.45
       fce  = 33.00
    From ((5.A5), TBDY):  cc = 0.00238888
         c = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
```

```
    c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
--------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      -------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
      -------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
      -------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
        u,f = 0.015
```

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------

s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139

suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
   2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 106.2028
    Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
   d = 200.00
   Av = 157079.633
   fy = 555.56

s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
       s/d = 0.50
   Vs2 = 523602.964 is calculated for section flange, with:
       d = 600.00
       Av = 157079.633
       fy = 555.56
       s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
       s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 372533.843
       f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
   where   is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
   orientation 1:   1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
   total thickness per orientation, tf1 = NL*t/NoDir = 1.016
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 259.312
       Ef = 64828.00
        fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.01
    From (11-11), ACI 440: Vs + Vf <= 572420.244
       bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 680731.279
   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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
       Mu = 106.0587
       Vu = 0.00038514
   d = 0.8*h = 600.00
   Nu = 9867.331
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
   where:
   Vs1 = 174534.321 is calculated for section web, with:
       d = 200.00
       Av = 157079.633
       fy = 555.56
       s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
       s/d = 0.50
   Vs2 = 523602.964 is calculated for section flange, with:
       d = 600.00
       Av = 157079.633
       fy = 555.56
       s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
       s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 372533.843
       f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
   where   is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,

as well as for 2 crack directions, $=45°$ and $=-45°$ to take into consideration the cyclic seismic loading.
orientation 1: $1 = b1 + 90° = 90.00$
$Vf = Min(|Vf(45, 1)|, |Vf(-45,a1)|)$, with:
total thickness per orientation, $tf1 = NL*t/NoDir = 1.016$
$dfv = d$ (figure 11.2, ACI 440) $= 707.00$
$ffe$ ((11-5), ACI 440) $= 259.312$
   $Ef = 64828.00$
    $fe = 0.004$, from (11.6a), ACI 440
     with $fu = 0.01$
From (11-11), ACI 440: $Vs + Vf <= 572420.244$
  $bw = 250.00$
------------------------------------------------------------
------------------------------------------------------------
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, $= 1.00$
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, $fc = fcm = 33.00$
New material of Secondary Member: Steel Strength, $fs = fsm = 555.56$
Concrete Elasticity, $Ec = 26999.444$
Steel Elasticity, $Es = 200000.00$
Max Height, $Hmax = 550.00$
Min Height, $Hmin = 250.00$
Max Width, $Wmax = 750.00$
Min Width, $Wmin = 250.00$
Eccentricity, $Ecc = 200.00$
Cover Thickness, $c = 25.00$
Element Length, $L = 3000.00$
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with $lb/ld = 0.30$
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, $t = 1.016$
Tensile Strength, $ffu = 1055.00$
Tensile Modulus, $Ef = 64828.00$
Elongation, $efu = 0.01$
Number of directions, $NoDir = 1$
Fiber orientations, bi: $0.00°$
Number of layers, $NL = 1$
Radius of rounding corners, $R = 40.00$
------------------------------------------------------------


Stepwise Properties
------------------------------------------------------------
Bending Moment, $M = -1.7126E+007$
Shear Force, $V2 = -5625.628$
Shear Force, $V3 = 204.073$
Axial Force, $F = -10617.103$
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
------------------------------------------------------------
------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity  θu,R = 1.0*θu = 0.04729749
  θu = θy + θp = 0.04729749


------------------------------------------------------------
 - Calculation of θy -
------------------------------------------------------------
 θy = (My*Ls/3)/Eleff = 0.00529749 ((4.29),Biskinis Phd))
  My = 3.9382E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3044.273
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 7.5439E+013
      factor = 0.30
         Ag = 262500.00
         fc' = 33.00
         N = 10617.103
      Ec*Ig = 2.5146E+014
------------------------------------------------------------
------------------------------------------------------------

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of θy and My according to Annex 7  -
------------------------------------------------------------
  θy = Min(θy_ten, θy_com)
  θy_ten = 3.1943925E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 707.00
      φy = 0.31100278
     A = 0.02934273
     B = 0.01565432
      with pt = 0.00696749
         pc = 0.00696749
         pv = 0.01521473
         N = 10617.103
         b = 250.00
          " = 0.06082037
  θy_comp = 1.0098067E-005
  with fc* (12.3, (ACI 440)) = 33.16756
     fc = 33.00
     fl = 0.56655003
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        ρg = pt + pc + pv = 0.02914971
        rc = 40.00
        Ae/Ac = 0.17542991
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      εfu = 0.01
     Ef = 64828.00
     Ec = 26999.444
      φy = 0.30972311
     A = 0.02901389
     B = 0.01546131
      with Es = 200000.00
------------------------------------------------------------
------------------------------------------------------------
```

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30


-----------------------------------------------------------
 - Calculation of  p -
-----------------------------------------------------------
From table 10-8:   p = 0.042
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VCol0E = 0.56632982
   d = 707.00
   s = 0.00
     t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
   Av = 78.53982, is the area of every stirrup
   Lstir = 1760.00, 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 = 10617.103
     Ag = 262500.00
     f'cE = 33.00
     fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
   b = 250.00
   d = 707.00
     f'cE = 33.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)


-----------------------------------------------------------
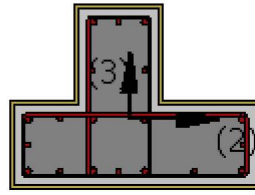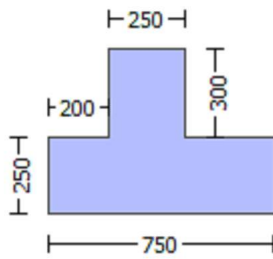
# Calculation No. 13

column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

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

Constant Properties
---------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
######################################################
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
######################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.7126E+007

Shear Force, Va = -5625.628
EDGE -B-
Bending Moment, Mb = 245343.925
Shear Force, Vb = 5625.628
BOTH EDGES
Axial Force, F = -10617.103
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
------------------------------------------------------------
------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 687174.813
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 687174.813
  VCol = 687174.813
  knl = 1.00
     displacement_ductility_demand = 0.0671293
------------------------------------------------------------
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' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 245343.925
     Vu = 5625.628
  d = 0.8*h = 600.00
  Nu = 10617.103
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 628318.531
  where:
  Vs1 = 157079.633 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 471238.898 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin   + cos   is replaced with (cot  +cota)sina which is more a generalised expression,
  where    is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,   =45° and   =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 498227.872

```
            bw = 250.00
-----------------------------------------------------------


-----------------------------------------------------------
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    = 3.5044526E-005
  y = (My*Ls/3)/EIeff = 0.00052205 ((4.29),Biskinis Phd))
   My = 3.9382E+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 = 7.5439E+013
      factor = 0.30
         Ag = 262500.00
         fc' = 33.00
         N = 10617.103
      Ec*Ig = 2.5146E+014
-----------------------------------------------------------
-----------------------------------------------------------


Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of  y and My according to Annex 7   -
-----------------------------------------------------------
  y = Min(  y_ten,  y_com)
  y_ten = 3.1943925E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 707.00
      y = 0.31100278
     A = 0.02934273
     B = 0.01565432
      with pt = 0.00696749
          pc = 0.00696749
          pv = 0.01521473
          N = 10617.103
          b = 250.00
           " = 0.06082037
   y_comp = 1.0098067E-005
  with fc* (12.3, (ACI 440)) = 33.16756
      fc = 33.00
      fl = 0.56655003
      b = bmax = 750.00
      h = hmax = 550.00
      Ag = 262500.00
         g = pt + pc + pv = 0.02914971
      rc = 40.00
      Ae/Ac = 0.17542991
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
     Ef = 64828.00
    Ec = 26999.444
     y = 0.30972311
    A = 0.02901389
    B = 0.01546131
     with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------


Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
```

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

# Calculation No. 14
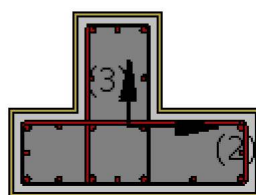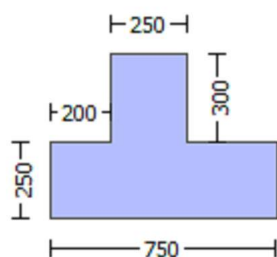
column C1, Floor 1

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

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,    = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889

Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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  =  0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 =  Max(Mu1+ , Mu1-) = 5.9036E+008
   Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
   Mu2+ = 5.9036E+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- = 2.9749E+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 = 1.2706712E-005
Mu = 5.9036E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00

d' = 43.00
v = 0.00078635
  N = 9867.331
fc = 33.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
   where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   -----------------------------------------------------------------
   fx = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
   effective stress from (A.35), ff,e = 809.387
   -----------------------------------------------------------------
   fy = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
   effective stress from (A.35), ff,e = 809.387
   -----------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00238888
   c = confinement factor = 1.03889

```
      y1 = 0.00140044
     sh1 = 0.0044814
    ft1 = 466.8167
    fy1 = 389.0139
     su1 = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.30
         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, ASCE41-17.
         with fs1 = fs = 389.0139
         with Es1 = Es = 200000.00
     y2 = 0.00140044
     sh2 = 0.0044814
    ft2 = 466.8167
    fy2 = 389.0139
     su2 = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 0.30
         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, ASCE41-17.
         with fs2 = fs = 389.0139
         with Es2 = Es = 200000.00
     yv = 0.00140044
     shv = 0.0044814
    ftv = 466.8167
    fyv = 389.0139
     suv = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.30
         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, ASCE41-17.
         with fsv = fs = 389.0139
         with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
     2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
     v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
         c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
     2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
```

su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u = su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------
--------------------------------------------------------------
--------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------

--------------------------------------------------------------
Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
--------------------------------------------------------------
with full section properties:
 b = 250.00
 d = 507.00
 d' = 43.00
 v = 0.00235905
  N = 9867.331
 fc = 33.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01138103
   we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
  where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  -------------------------------------------------------------
   fx = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
    bmax = 750.00
    hmax = 550.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
    effective stress from (A.35), ff,e = 809.387
  -------------------------------------------------------------
   fy = 0.02979558
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.14946032
  with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
    bmax = 750.00
    hmax = 550.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
    effective stress from (A.35), ff,e = 809.387
  -------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY):  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
   v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  u =   su (4.1) = 1.2514519E-005
----------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-------------------------------------------------------------------
-------------------------------------------------------------------
-------------------------------------------------------------------
Calculation of Mu2+
-------------------------------------------------------------------

-------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2706712E-005
Mu = 5.9036E+008
-------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:   cu* = shear_factor * Max( cu,  cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
     fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
     fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 0.00
  bmax = 750.00
  hmax = 550.00
  From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
  effective stress from (A.35), ff,e = 809.387

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

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
  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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
  Lstir (Length of stirrups along Y) = 1760.00
  Astir (stirrups area) = 78.53982
  Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
  Lstir (Length of stirrups along X) = 1360.00
  Astir (stirrups area) = 78.53982
  Asec (section area) = 262500.00

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

  s = 100.00
  fywe = 694.45
  fce = 33.00
From ((5A5), TBDY), TBDY:  cc = 0.00238888
  c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
        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, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        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, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
    2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
       c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
     2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
  u =   su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2514519E-005
Mu = 2.9749E+008
----------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 507.00
   d' = 43.00

v = 0.00235905
   N = 9867.331
fc = 33.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
   where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----------------------------------------------------------------
   fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
   ----------------------------------------------------------------
   fy = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
   ----------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
   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) = 0.00406911
         Lstir (Length of stirrups along Y) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
   ----------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
         Lstir (Length of stirrups along X) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
   ----------------------------------------------------------------
         s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY: cc = 0.00238888
         c = confinement factor = 1.03889
 y1 = 0.00140044

sh1 = 0.0044814
  ft1 = 466.8167
  fy1 = 389.0139
   su1 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
       with fs1 = fs = 389.0139
       with Es1 = Es = 200000.00
   y2 = 0.00140044
    sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.30
      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, ASCE41-17.
       with fs2 = fs = 389.0139
       with Es2 = Es = 200000.00
   yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
   v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
   2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
   v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775

Mu = MRc (4.14) = 2.9749E+008
φu = φsu (4.1) = 1.2514519E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.4831
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by αCol1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by αCol2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    ψf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sinβ + cosβ is replaced with (cotθ+cota)sina which is more a generalised expression,
  where θ is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(θ,α), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
  orientation 1: α1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,α1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    εfe = 0.004, from (11.6a), ACI 440
      with εfu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
-------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254

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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
   Mu = 21.68208
   Vu = 6.0494360E-005
 d = 0.8*h = 440.00
 Nu = 9867.331
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
 where:
 Vs1 = 383975.507 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs1 is multiplied by Col1 = 1.00
   s/d = 0.22727273
 Vs2 = 174534.321 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs2 is multiplied by Col2 = 1.00
   s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 267149.446
   f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
 where   is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:  1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 507.00
 ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
     with  fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 419774.846
   bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------
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,  = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.7828E+008
   Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
   Mu2+ = 5.7828E+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- = 5.7828E+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 = 9.2773974E-006
Mu = 5.7828E+008
---------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  ν = 0.00169171
    N = 9867.331
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00

```
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    -----------------------------------------------------------------
        s = 100.00
      fywe = 694.45
      fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00238888
        c  = confinement factor = 1.03889
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
```

```
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
     cc (5A.5, TBDY) = 0.00238888
        c  = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
     2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
     v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------

--------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
--------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       fx = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
        bmax = 750.00
        hmax = 550.00
        From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ----------------------------------------------------------------
       fy = 0.02979558
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.14946032
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 750.00
        hmax = 550.00
        From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
        effective stress from (A.35), ff,e = 809.387
     ----------------------------------------------------------------
       R = 40.00
```

Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
   Lstir (Length of stirrups along Y) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
-----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
   Lstir (Length of stirrups along X) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
-----------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
  c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  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, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00

yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       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, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =  su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
     N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

---------------------------------------------------------------
   fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
---------------------------------------------------------------
   fy = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032
   with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
         bw = 250.00
      effective stress from (A.35), ff,e = 809.387
---------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
   u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
      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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
   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) = 0.00406911
         Lstir (Length of stirrups along Y) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
---------------------------------------------------------------
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
         Lstir (Length of stirrups along X) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
---------------------------------------------------------------
      s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00238888
      c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 34.2833
cc (5A.5, TBDY) = 0.00238888
c = confinement factor = 1.03889
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
u = su (4.1) = 9.2773974E-006
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------

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

-------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
-------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982

Asec (section area) = 262500.00
------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
b = 190.00
d = 677.00

d' = 13.00
   fcc (5A.2, TBDY) = 34.2833
    cc (5A.5, TBDY) = 0.00238888
       c = confinement factor = 1.03889
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
     2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
     v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =    su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 680731.279
   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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 106.2028
      Vu = 0.00038514
   d = 0.8*h = 600.00
   Nu = 9867.331
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
   where:
   Vs1 = 174534.321 is calculated for section web, with:
      d = 200.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.50
   Vs2 = 523602.964 is calculated for section flange, with:
      d = 600.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 372533.843
      f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
   where    is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
   orientation 1:   1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
   From (11-11), ACI 440: Vs + Vf < = 572420.244
      bw = 250.00
------------------------------------------------------------
---------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 680731.279
   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' = 33.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
      Mu = 106.0587
      Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
     d = 200.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
     s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
     d = 600.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
     s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
     f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where    is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 +  90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
   From (11-11), ACI 440: Vs + Vf < = 572420.244
      bw = 250.00
------------------------------------------------------------
------------------------------------------------------------
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,    = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
Bending Moment, M = -206750.678
Shear Force, V2 = 5625.628
Shear Force, V3 = -204.073
Axial Force, F = -10617.103
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
---------------------------------------------------------------
---------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R = 1.0*  u = 0.04506386
  u =   y +   p = 0.04506386


---------------------------------------------------------------
 - Calculation of   y -
---------------------------------------------------------------
  y = (My*Ls/3)/EIeff = 0.00306386 ((4.29),Biskinis Phd))
    My = 4.1082E+008

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Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1013.121
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 4.5281E+013
   factor = 0.30
      Ag = 262500.00
      fc' = 33.00
      N = 10617.103
   Ec*Ig = 1.5094E+014
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
--------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
--------------------------------------------------------------
 y = Min( y_ten, y_com)
 y_ten = 4.2687014E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 507.00
     y = 0.28101237
    A = 0.01363926
    B = 0.00916303
     with pt = 0.00594858
         pc = 0.00218115
         pv = 0.00541982
         N = 10617.103
         b = 750.00
          " = 0.08481262
 y_comp = 1.5576525E-005
 with fc* (12.3, (ACI 440)) = 33.18002
    fc = 33.00
    fl = 0.56655003
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
        g = pt + pc + pv = 0.01354954
       rc = 40.00
       Ae/Ac = 0.18847004
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
    Ef = 64828.00
    Ec = 26999.444
     y = 0.28010173
    A = 0.01348643
    B = 0.00907331
     with Es = 200000.00
CONFIRMATION: y = 0.28046145 < t/d
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30

--------------------------------------------------------------
 - Calculation of  p -
--------------------------------------------------------------
From table 10-8:  p = 0.042
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 0.78798666
   d = 507.00

s = 0.00

  t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00

Av = 78.53982, is the area of every stirrup

Lstir = 1360.00, 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 = 10617.103

  Ag = 262500.00

  f'cE = 33.00

  fytE = fylE = 0.00

pl = Area_Tot_Long_Rein/(b*d) = 0.01354954

  b = 750.00

  d = 507.00

  f'cE = 33.00

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

End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1

At local axis: 2

Integration Section: (b)

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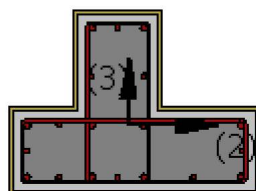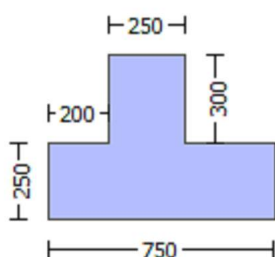
---

# Calculation No. 15

column C1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)



Start Of Calculation of Shear Capacity for element: column TC1 of floor 1

At local axis: 3

Integration Section: (b)

Section Type: rctcs

Constant Properties

```
------------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of  y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm =  33.00
New material: Steel Strength, fs = fsm = 555.56
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -404578.584
Shear Force, Va = 204.073
EDGE -B-
Bending Moment, Mb = -206750.678
Shear Force, Vb = -204.073
BOTH EDGES
Axial Force, F = -10617.103
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
------------------------------------------------------------
------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 486207.064
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 486207.064
   VCol = 486207.064
```

```
    knl = 1.00
      displacement_ductility_demand = 5.1163364E-006
-------------------------------------------------------------
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' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.30255
     Mu = 206750.678
     Vu = 204.073
  d = 0.8*h = 440.00
  Nu = 10617.103
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
  where:
  Vs1 = 345575.192 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 157079.633 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where  is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 365367.106
    bw = 250.00
-------------------------------------------------------------

-------------------------------------------------------------
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    = 1.5675735E-008
 y = (My*Ls/3)/EIeff = 0.00306386 ((4.29),Biskinis Phd))
  My = 4.1082E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1013.121
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 4.5281E+013
    factor = 0.30
      Ag = 262500.00
      fc' = 33.00
      N = 10617.103
    Ec*Ig = 1.5094E+014
-------------------------------------------------------------

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

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 750.00
web width, bw = 250.00
flange thickness, t = 250.00
------------------------------------------------------------

   y = Min( y_ten,  y_com)
   y_ten = 4.2687014E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 507.00
      y = 0.28101237
     A = 0.01363926
     B = 0.00916303
      with pt = 0.00594858
          pc = 0.00218115
          pv = 0.00541982
          N = 10617.103
          b = 750.00
           " = 0.08481262
   y_comp = 1.5576525E-005
  with fc* (12.3, (ACI 440)) = 33.18002
      fc = 33.00
      fl = 0.56655003
      b = bmax = 750.00
      h = hmax = 550.00
      Ag = 262500.00
          g = pt + pc + pv = 0.01354954
        rc = 40.00
        Ae/Ac = 0.18847004
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      effective strain from (12.5) and (12.12), efe = 0.004
       fu = 0.01
      Ef = 64828.00
     Ec = 26999.444
      y = 0.28010173
     A = 0.01348643
     B = 0.00907331
     with Es = 200000.00
CONFIRMATION:  y = 0.28046145 < t/d
------------------------------------------------------------
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

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

## Calculation No. 16
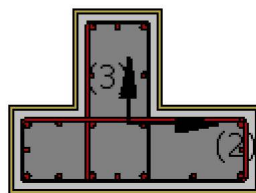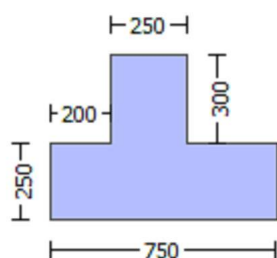
column C1, Floor 1

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

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,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00

Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
---------------------------------------------------------------

Stepwise Properties
---------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = 6.0494360E-005
EDGE -B-
Shear Force, Vb = -6.0494360E-005
BOTH EDGES
Axial Force, F = -9867.331
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 = 0.78798666
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 393570.381
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.9036E+008
  Mu1+ = 5.9036E+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- = 2.9749E+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-) = 5.9036E+008
  Mu2+ = 5.9036E+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- = 2.9749E+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 = 1.2706712E-005
Mu = 5.9036E+008
----------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00078635
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:   cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:   cu = 0.01138103
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
     fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
   bmax = 750.00
   hmax = 550.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
   bmax = 750.00
   hmax = 550.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
     bw = 250.00
   effective stress from (A.35), ff,e = 809.387
-----------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
  u,f = 0.015
  ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
   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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
   -----------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
  2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u = su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu1-
-------------------------------------------------------------------------

---------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.2514519E-005
Mu = 2.9749E+008
---------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
    N = 9867.331
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01138103
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.03881913
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ---------------------------------------------------------------------
      ωfx = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------------
      ωfy = 0.02979558
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.14946032
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ---------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00406911
    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) = 0.00406911
        Lstir (Length of stirrups along Y) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ---------------------------------------------------------------------
      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591

```
         Lstir (Length of stirrups along X) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
    ----------------------------------------------------------------
         s = 100.00
       fywe = 694.45
        fce = 33.00
    From ((5.A5), TBDY):  cc = 0.00238888
         c = confinement factor = 1.03889
   y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
   y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
   yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
    v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
```

```
          c  = confinement factor = 1.03889
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
      2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
      v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
 v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
   u =    su (4.1) = 1.2514519E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------------


----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 1.2706712E-005
Mu = 5.9036E+008
----------------------------------------------------------------------------
with full section properties:
   b = 750.00
   d = 507.00
   d' = 43.00
   v = 0.00078635
      N = 9867.331
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of   cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01138103
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.03881913
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      -----------------------------------------------------------------
        fx = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333
         bmax = 750.00
         hmax = 550.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
            bw = 250.00
         effective stress from (A.35), ff,e = 809.387
      -----------------------------------------------------------------
        fy = 0.02979558
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.14946032
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 750.00
         hmax = 550.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.008128
            bw = 250.00
         effective stress from (A.35), ff,e = 809.387
      -----------------------------------------------------------------
         R = 40.00
         Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
         fu,f = 1055.00
         Ef = 64828.00
          u,f = 0.015
```

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

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

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

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

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00238888
c = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139

suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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 $\varepsilon_{yv}$, 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, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.07012363
  2 = Asl,com/(b*d)*(fs2/fc) = 0.025712
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06389042
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
   c = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08101513
  2 = Asl,com/(b*d)*(fs2/fc) = 0.02970555
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07381378
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20525313
Mu = MRc (4.14) = 5.9036E+008
 u =  su (4.1) = 1.2706712E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
 u = 1.2514519E-005
Mu = 2.9749E+008
--------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00235905
   N = 9867.331
  fc = 33.00
  co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01138103
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.03881913
   where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   --------------------------------------------------------------
    fx = 0.02979558
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.14946032

with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3 = 39233.333$
  bmax = 750.00
  hmax = 550.00
  From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
  effective stress from (A.35), ff,e = 809.387
--------------------------------------------------------------
  fy = 0.02979558
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.14946032
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00$
  bmax = 750.00
  hmax = 550.00
  From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
    bw = 250.00
  effective stress from (A.35), ff,e = 809.387
--------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
    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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
--------------------------------------------------------------
  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
--------------------------------------------------------------
   s = 100.00
  fywe = 694.45
  fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00238888
    c  = confinement factor = 1.03889
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.

```
        with fs1 = fs = 389.0139
        with Es1 = Es = 200000.00
    y2 = 0.00140044
    sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.30
      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, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
    yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      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, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.07713599
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21037088
    v = Asl,mid/(b*d)*(fsv/fc) = 0.19167125
and confined core properties:
   b = 190.00
   d = 477.00
   d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10787804
    2 = Asl,com/(b*d)*(fs2/fc) = 0.29421283
    v = Asl,mid/(b*d)*(fsv/fc) = 0.26806058
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.19304775
Mu = MRc (4.14) = 2.9749E+008
  u =   su (4.1) = 1.2514519E-005
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 499463.254
----------------------------------------------------------------------------
```

Calculation of Shear Strength at edge 1, Vr1 = 499463.254
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.4831
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 499463.254
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 499463.254
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 21.68208
    Vu = 6.0494360E-005
  d = 0.8*h = 440.00
  Nu = 9867.331
  Ag = 137500.00

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 383975.507 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 174534.321 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 267149.446
    $\phi$f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, $\theta$ =45° and $\theta$ =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  $\alpha$1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, $\alpha$1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    $\epsilon$fe = 0.004, from (11.6a), ACI 440
      with $\epsilon$fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 419774.846
    bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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, $\gamma$ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##########################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##########################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.03889

Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00038514
EDGE -B-
Shear Force, Vb = -0.00038514
BOTH EDGES
Axial Force, F = -9867.331
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  =  0.56632982
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 385518.423
with
Mpr1 =  Max(Mu1+ , Mu1-) = 5.7828E+008
    Mu1+ = 5.7828E+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- = 5.7828E+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-) = 5.7828E+008
    Mu2+ = 5.7828E+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- = 5.7828E+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 = 9.2773974E-006
Mu = 5.7828E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00

d' = 43.00
v = 0.00169171
    N = 9867.331
fc = 33.00
  co (5A.5, TBDY) = 0.002
Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
       fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
       fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
       bmax = 750.00
       hmax = 550.00
       From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
          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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00406911
    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) = 0.00406911
          Lstir (Length of stirrups along Y) = 1760.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 262500.00
    ----------------------------------------------------------------
       psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
          Lstir (Length of stirrups along X) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 262500.00
    ----------------------------------------------------------------
          s = 100.00
       fywe = 694.45
       fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00238888
       c = confinement factor = 1.03889

```
       y1 = 0.00140044
       sh1 = 0.0044814
    ft1 = 466.8167
    fy1 = 389.0139
      su1 = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/ld = 0.30
            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, ASCE41-17.
            with fs1 = fs = 389.0139
            with Es1 = Es = 200000.00
      y2 = 0.00140044
      sh2 = 0.0044814
    ft2 = 466.8167
    fy2 = 389.0139
      su2 = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/lb,min = 0.30
            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, ASCE41-17.
            with fs2 = fs = 389.0139
            with Es2 = Es = 200000.00
      yv = 0.00140044
      shv = 0.0044814
    ftv = 466.8167
    fyv = 389.0139
      suv = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/ld = 0.30
            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, ASCE41-17.
            with fsv = fs = 389.0139
            with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
      2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
      v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
    b = 190.00
    d = 677.00
    d' = 13.00
    fcc (5A.2, TBDY) = 34.2833
      cc (5A.5, TBDY) = 0.00238888
          c  = confinement factor = 1.03889
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
      2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
      v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
    ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
```

su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
 u =   su (4.1) = 9.2773974E-006
----------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------
--------------------------------------------------------------
--------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------

--------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
--------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
    N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.03881913
    where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
     fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 39233.333
      bmax = 750.00
      hmax = 550.00
      From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
     fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
      bmax = 750.00
      hmax = 550.00
      From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
        bw = 250.00
      effective stress from (A.35), ff,e = 809.387
    ----------------------------------------------------------------
     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     fu,f = 1055.00
     Ef = 64828.00
      u,f = 0.015
     ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
        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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00406911
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) = 0.00406911
Lstir (Length of stirrups along Y) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
Lstir (Length of stirrups along X) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
------------------------------------------------------------------
s = 100.00
fywe = 694.45
fce  = 33.00
From ((5.A5), TBDY:  cc = 0.00238888
c  = confinement factor = 1.03889
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
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, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
   2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
      c  = confinement factor = 1.03889
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
------------------------------------------------------------------
------------------------------------------------------------------
------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------

------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00169171
     N = 9867.331
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01138103
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01138103
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+ Min(  fx,   fy) = 0.03881913
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    --------------------------------------------------------------
     fx = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
    with Unconfined area = ((bmax-2R)^ 2+ (hmax-2R)^ 2)/3 = 39233.333
       bmax = 750.00
       hmax = 550.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.008128
          bw = 250.00
       effective stress from (A.35), ff,e = 809.387
    --------------------------------------------------------------
     fy = 0.02979558
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)

af = 0.14946032
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 750.00
    hmax = 550.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.008128
      bw = 250.00
    effective stress from (A.35), ff,e = 809.387
----------------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35126065
     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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00406911
  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) = 0.00406911
    Lstir (Length of stirrups along Y) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----------------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
    Lstir (Length of stirrups along X) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----------------------------------------------------------------------
    s = 100.00
    fywe = 694.45
    fce  = 33.00
  From ((5.A5), TBDY:  cc = 0.00238888
    c  = confinement factor = 1.03889
y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  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, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     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, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     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, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
    2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.2833
   cc (5A.5, TBDY) = 0.00238888
     c = confinement factor = 1.03889
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748
Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------
--------------------------------------------------------------
--------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------

--------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.2773974E-006
Mu = 5.7828E+008
--------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00

$v = 0.00169171$

$N = 9867.331$

$fc = 33.00$

$co$ (5A.5, TBDY) = 0.002

Final value of $cu$: $cu^* =$ shear_factor $*$ Max( $cu$, $cc$) = 0.01138103

   The Shear_factor is considered equal to 1 (pure moment strength)

   From (5.4b), TBDY: $cu = 0.01138103$

     $we$ ((5.4c), TBDY) = $ase^*$ $sh,min^*fywe/fce + Min(\ fx,\ fy) = 0.03881913$

   where $\ f = af^*pf^*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

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

   $fx = 0.02979558$

Expression ((15B.6), TBDY) is modified as $af = 1 - $ (Unconfined area)/(total area)

$af = 0.14946032$

with Unconfined area = $((bmax-2R)^2 + (hmax-2R)^2)/3 = 39233.333$

   $bmax = 750.00$

   $hmax = 550.00$

   From EC8 A.4.4.3(6), $pf = 2tf/bw = 0.008128$

     $bw = 250.00$

   effective stress from (A.35), $ff,e = 809.387$

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

   $fy = 0.02979558$

Expression ((15B.6), TBDY) is modified as $af = 1 - $ (Unconfined area)/(total area)

$af = 0.14946032$

with Unconfined area = $((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00$

   $bmax = 750.00$

   $hmax = 550.00$

   From EC8 A.4.4.3(6), $pf = 2tf/bw = 0.008128$

     $bw = 250.00$

   effective stress from (A.35), $ff,e = 809.387$

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

   $R = 40.00$

   Effective FRP thickness, $tf = NL^*t^*Cos(b1) = 1.016$

   $fu,f = 1055.00$

   $Ef = 64828.00$

   $u,f = 0.015$

   $ase = $ Max$(((Aconf,max-AnoConf)/Aconf,max)^*(Aconf,min/Aconf,max),0) = 0.35126065$

     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 = 188100.00 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 = 137025.00 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 = 97400.00 is the unconfined core area which is equal to $\ bi2/6$ as defined at (A.2).

   $psh,min = $ Min$(psh,x$ , $psh,y) = 0.00406911$

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) = $Lstir^*Astir/(Asec^*s) = 0.00406911$

     Lstir (Length of stirrups along Y) = 1760.00

     Astir (stirrups area) = 78.53982

     Asec (section area) = 262500.00

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

   $psh,y$ ((5.4d), TBDY) = $Lstir^*Astir/(Asec^*s) = 0.00526591$

     Lstir (Length of stirrups along X) = 1360.00

     Astir (stirrups area) = 78.53982

     Asec (section area) = 262500.00

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

     $s = 100.00$

   $fywe = 694.45$

   $fce = 33.00$

  From ((5.A5), TBDY), TBDY: $cc = 0.00238888$

     $c = $ confinement factor = 1.03889

$y1 = 0.00140044$

sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   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, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   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, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0821349
 2 = Asl,com/(b*d)*(fs2/fc) = 0.0821349
 v = Asl,mid/(b*d)*(fsv/fc) = 0.17935581
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.2833
  cc (5A.5, TBDY) = 0.00238888
    c  = confinement factor = 1.03889
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11286126
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11286126
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24645214
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.21940748

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Mu = MRc (4.14) = 5.7828E+008
  u =   su (4.1) = 9.2773974E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 680731.279
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 680731.279
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279
  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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 106.2028
      Vu = 0.00038514
   d = 0.8*h = 600.00
   Nu = 9867.331
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
   where:
   Vs1 = 174534.321 is calculated for section web, with:
      d = 200.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.50
   Vs2 = 523602.964 is calculated for section flange, with:
      d = 600.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 372533.843
      f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
   where   is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
   orientation 1:   1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
   total thickness per orientation, tf1 = NL*t/NoDir = 1.016
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
       fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
   From (11-11), ACI 440: Vs + Vf <= 572420.244
      bw = 250.00
------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 680731.279
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 680731.279

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' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 106.0587
     Vu = 0.00038514
  d = 0.8*h = 600.00
  Nu = 9867.331
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 698137.286
  where:
  Vs1 = 174534.321 is calculated for section web, with:
     d = 200.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
     s/d = 0.50
  Vs2 = 523602.964 is calculated for section flange, with:
     d = 600.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
     s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 372533.843
     f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 572420.244
     bw = 250.00
-------------------------------------------------------------
-------------------------------------------------------------
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,  = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56

Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
--------------------------------------------------------------

Stepwise Properties
--------------------------------------------------------------
Bending Moment, M = 245343.925
Shear Force, V2 = 5625.628
Shear Force, V3 = -204.073
Axial Force, F = -10617.103
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
--------------------------------------------------------------
--------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity  θu,R = 1.0* θu = 0.04252205
 θu = θy + θp = 0.04252205


--------------------------------------------------------------
 - Calculation of θy -
--------------------------------------------------------------
 θy = (My*Ls/3)/Eleff = 0.00052205 ((4.29),Biskinis Phd))
  My = 3.9382E+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 = 7.5439E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 33.00
       N = 10617.103
    Ec*Ig = 2.5146E+014
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of θy and My according to Annex 7  -

------------------------------------------------------------
  y = Min( y_ten, y_com)
  y_ten = 3.1943925E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
   d = 707.00
    y = 0.31100278
   A = 0.02934273
   B = 0.01565432
    with pt = 0.00696749
      pc = 0.00696749
      pv = 0.01521473
      N = 10617.103
      b = 250.00
      " = 0.06082037
  y_comp = 1.0098067E-005
 with fc* (12.3, (ACI 440)) = 33.16756
   fc = 33.00
   fl = 0.56655003
   b = bmax = 750.00
   h = hmax = 550.00
   Ag = 262500.00
     g = pt + pc + pv = 0.02914971
    rc = 40.00
    Ae/Ac = 0.17542991
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.01
  Ef = 64828.00
  Ec = 26999.444
   y = 0.30972311
   A = 0.02901389
   B = 0.01546131
   with Es = 200000.00
------------------------------------------------------------
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30


------------------------------------------------------------
 - Calculation of  p -
------------------------------------------------------------
From table 10-8:  p = 0.042
with:
- Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VCol0E = 0.56632982
 d = 707.00
 s = 0.00
  t = Av/(bw*s) + 2*tf/bw*(ffe/fs) = Av*Lstir/(Ag*s) + 2*tf/bw*(ffe/fs) = 0.00
 Av = 78.53982, is the area of every stirrup
 Lstir = 1760.00, 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 = 10617.103
  Ag = 262500.00
  f'cE = 33.00
  fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
  b = 250.00
  d = 707.00
  f'cE = 33.00
------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)