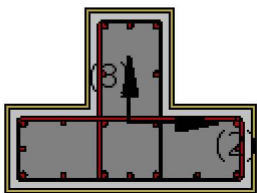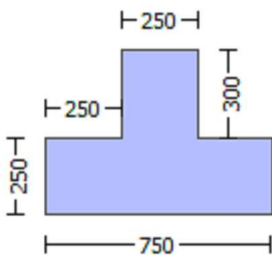# Detailed Member Calculations

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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.4290E+007
Shear Force, Va = -4719.14
EDGE -B-
Bending Moment, Mb = 129045.796
Shear Force, Vb = 4719.14
BOTH EDGES
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 1231.504
    -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 441138.705
Vn ((10.3), ASCE 41-17) = knl*VColO = 474342.694
   VCol = 474342.694
   knl = 1.00
      displacement_ductility_demand = 0.01701013

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

    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
  Mu = 1.4290E+007
  Vu = 4719.14
d = 0.8*h = 600.00
Nu = 10332.611
Ag = 187500.00
From (11.5.4.8), ACI 318-14: $Vs = Vs1 + Vs2 = 502654.825$
where:
Vs1 = 125663.706 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 400.00
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.50
Vs2 = 376991.118 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 400.00
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 463792.00
  ψf = 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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
  ϵfe = 0.004, from (11.6a), ACI 440
   with ϵfu = 0.009
From (11-11), ACI 440: Vs + Vf <= 398582.298
  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 = 0.00010413
y = (My*Ls/3)/Eleff = 0.00612151 ((4.29),Biskinis Phd))
My = 3.5105E+008
Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3028.132
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.7884E+013
  factor = 0.30
   Ag = 262500.00
   fc' = 20.00
   N = 10332.611
  Ec*Ig = 1.9295E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
y = Min(y_ten, y_com)
y_ten = 2.9883804E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 281.4121

```
       d = 707.00
       y = 0.33402563
       A = 0.02935745
       B = 0.01566904
      with pt = 0.00696749
          pc = 0.00696749
          pv = 0.01521473
          N = 10332.611
          b = 250.00
          " = 0.06082037
   y_comp = 7.3563789E-006
  with fc* (12.3, (ACI 440)) = 20.20861
       fc = 20.00
       fl = 0.70533557
       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) = 1.00
       effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.009
       Ef = 82000.00
      Ec = 21019.039
       y = 0.33274584
       A = 0.02898082
       B = 0.01546131
      with Es = 200000.00
------------------------------------------------------------
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
   cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
------------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00

Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
   Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
   Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01249217
       ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
     where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ωfx = 0.03840724
     Expression ((15B.6), TBDY) is modified as αf = 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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
     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) = 1760.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 262500.00
    ----
    s = 100.00
   fywe = 555.55
   fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
 y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
   with Es1 = Es = 200000.00
 y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
 v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
  v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
 u = su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
        = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
```


Calculation of Mu1-

Calculation of ultimate curvature ϕu according to 4.1, Biskinis/Fardis 2013:
  ϕu = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu^* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = $\alpha se^* \rho sh,min^*fywe/fce+Min(\omega fx, \omega fy)$ = 0.05053697
    where ωf = $\alpha f^*\rho f^*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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), ρf = 2tf/bw = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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), ρf = 2tf/bw = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       $\varepsilon u,f$ = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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)

9.
```

"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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

--------------------------------------------------------------------
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY:  cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
    v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.5419151E-005
Mu = 4.4919E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244

N = 9867.335
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    --------------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    --------------------------------------------------------------------
      fy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    --------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    --------------------------------------------------------------------
        s = 100.00
      fywe = 555.55
      fce  = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529

ft1 = 363.7704
fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
      with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
ftv = 363.7704
fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
    v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->

su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------

----------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
----------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    --------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    --------------------------------------------------------------
      fy = 0.03840724
    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 = 0.008
        bw = 250.00

effective stress from (A.35), ff,e = 642.432

---------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ---------------------------------------------------------------
        s = 100.00
        fywe = 555.55
        fce = 20.00
    From ((5.A5), TBDY, TBDY:  cc = 0.00271051
        c  = confinement factor = 1.07105
  y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Es1 = Es = 200000.00
  y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
   with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
   v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =  su (4.1) = 1.1097366E-005
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
   = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
  cb = 25.00
  Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955

```
---------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 451299.955
   knl = 1 (zero step-static loading)
---------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1106.371
      Vu = 1.2475615E-020
   d = 0.8*h = 440.00
   Nu = 9867.335
   Ag = 137500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
   where:
   Vs1 = 307174.877 is calculated for section web, with:
      d = 440.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.22727273
   Vs2 = 139624.944 is calculated for section flange, with:
      d = 200.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 332592.00
      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 = 1.00
   dfv = d (figure 11.2, ACI 440) = 507.00
   ffe ((11-5), ACI 440) = 328.00
      Ef = 82000.00
       fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 326794.274
      bw = 250.00
---------------------------------------------------------------
---------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 451299.955
   knl = 1 (zero step-static loading)
---------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1106.371
      Vu = 1.2475615E-020
   d = 0.8*h = 440.00
   Nu = 9867.335
```

Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
where:
Vs1 = 307174.877 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
Vs2 = 139624.944 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
    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, = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00

Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
   Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
   Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00

d = 707.00
d' = 43.00
ν = 0.00279133
 N = 9867.335
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+ Min(fx, fy) = 0.05053697
   where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
      fx = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432
   ----
      fy = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       u,f = 0.015
      ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
         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 = 95733.333 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) = 1360.00
         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) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
      ----
         s = 100.00
         fywe = 555.55
         fce = 20.00
      From ((5.A5), TBDY), TBDY: cc = 0.00271051

c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
  c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied

--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
     fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ----
     fy = 0.03840724
    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 = 0.008
   bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
   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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

----

s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
   = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 t = 1.00
 s = 0.80
 e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
 s = 100.00
 n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  ν = 0.00279133
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
              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) = 1760.00
              Astir (stirrups area) = 78.53982
              Asec (section area) = 262500.00
         -----------------------------------------------------------------
              s = 100.00
           fywe = 555.55
           fce  = 20.00
         From ((5.A5), TBDY), TBDY:  cc = 0.00271051
              c  = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
  ft1 = 363.7704
 fy1 = 303.142
   su1 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
    y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
 fy2 = 303.142
   su2 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
    yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
 fyv = 303.142
   suv = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
    v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
```

```
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
       c = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
     2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
     v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
Calculation of Mu2-
-----------------------------------------------------------------------------

-----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027933
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
    bw = 250.00
  effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
    bw = 250.00
  effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
    s = 100.00
   fywe = 555.55
   fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
     c = confinement factor = 1.07105
 y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
-------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
  --------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
  --------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 445628.556
```

```
    bw = 250.00
-------------------------------------------------------
-----------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
-------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
    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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -206128.725
Shear Force, V2 = -4719.14
Shear Force, V3 = 106.0256
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = * u = 0.00583828
 u = y + p = 0.00627772

 - Calculation of y -
----
 y = (My*Ls/3)/EIeff = 0.00627772 ((4.29),Biskinis Phd))
  My = 3.4149E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1944.141
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.5251E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 20.00
       N = 10332.611
    Ec*Ig = 1.1750E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
  y = Min(y_ten, y_com)
  y_ten = 4.8877902E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 507.00
      y = 0.43220405
     A = 0.0409383
     B = 0.02750961
      with pt = 0.01784573
         pc = 0.00654344
         pv = 0.01625945
         N = 10332.611
         b = 250.00
          " = 0.08481262
   y_comp = 7.9064364E-006
  with fc* (12.3, (ACI 440)) = 20.19686
     fc = 20.00
     fl = 0.70533557
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        g = pt + pc + pv = 0.04064862
      rc = 40.00
      Ae/Ac = 0.16554652
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.009
     Ef = 82000.00
     Ec = 21019.039
      y = 0.43147412
     A = 0.04041295
     B = 0.02721993
      with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00

 - 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 = 0.66355027
  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 = 10332.611
   Ag = 262500.00
   f'cE = 20.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.04064862
  b = 250.00
  d = 507.00
   f'cE = 20.00

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

Calculation No. 3

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
###
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -206128.725
Shear Force, Va = 106.0256
EDGE -B-
Bending Moment, Mb = -111229.264
Shear Force, Vb = -106.0256
BOTH EDGES
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2261.947
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 323753.879
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 348122.451
  VCol = 348122.451
  knl = 1.00
      displacement_ductility_demand = 0.00328081

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

     = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 206128.725
     Vu = 106.0256
  d = 0.8*h = 440.00
  Nu = 10332.611
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 402123.86
  where:
  Vs1 = 276460.154 is calculated for section web, with:
     d = 440.00
     Av = 157079.633
     fy = 400.00
     s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
     s/d = 0.22727273
  Vs2 = 125663.706 is calculated for section flange, with:
     d = 200.00
     Av = 157079.633
     fy = 400.00
     s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
     s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
     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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
        with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 292293.685
     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   = 2.0596012E-005
 y = (My*Ls/3)/Eleff = 0.00627772 ((4.29),Biskinis Phd))
  My = 3.4149E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1944.141
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 3.5251E+013
     factor = 0.30
       Ag = 262500.00
       fc' = 20.00

```
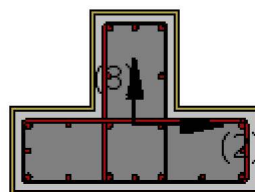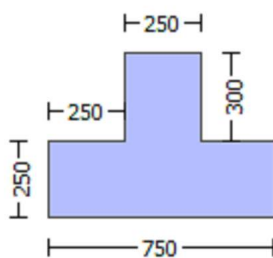        N = 10332.611
     Ec*Ig = 1.1750E+014
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of   y and My according to Annex 7   -
--------------------------------------------------------------
  y = Min( y_ten, y_com)
  y_ten = 4.8877902E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 507.00
      y = 0.43220405
     A = 0.0409383
     B = 0.02750961
      with pt = 0.01784573
          pc = 0.00654344
          pv = 0.01625945
          N = 10332.611
          b = 250.00
          " = 0.08481262
  y_comp = 7.9064364E-006
 with fc* (12.3, (ACI 440)) = 20.19686
     fc = 20.00
     fl = 0.70533557
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
        g = pt + pc + pv = 0.04064862
       rc = 40.00
       Ae/Ac = 0.16554652
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      effective strain from (12.5) and (12.12), efe = 0.004
       fu = 0.009
      Ef = 82000.00
      Ec = 21019.039
       y = 0.43147412
      A = 0.04041295
      B = 0.02721993
       with Es = 200000.00
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
--------------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00

Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
   Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
   Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00

v = 0.00389244
   N = 9867.335
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
   where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
     fx = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432
   ----
     fy = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432

     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
     fu,f = 840.00
     Ef = 82000.00
      u,f = 0.015
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
   ----
        s = 100.00
       fywe = 555.55
       fce = 20.00
   From ((5A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309

sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Es1 = Es = 200000.00
   y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
      with Es2 = Es = 200000.00
   yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
   v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
   v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied

```
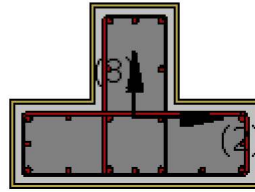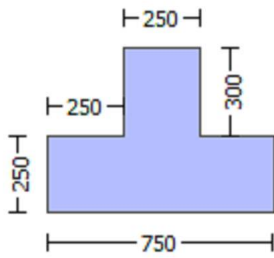--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005
---------------------------------------------------------------


Calculation of ratio lb/ld
---------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Mu1-
------------------------------------------------------------------------

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ------------------------------------------------------------------
      fy = 0.03840724
    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 = 0.008
```

bw = 250.00
        effective stress from (A.35), ff,e = 642.432

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
        fu,f = 840.00
        Ef = 82000.00
         u,f = 0.015
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
            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 = 95733.333 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) = 1360.00
            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) = 1760.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
        ----
         s = 100.00
         fywe = 555.55
         fce = 20.00
      From ((5.A5), TBDY), TBDY: cc = 0.00271051
         c = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Es1 = Es = 200000.00
    y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
   with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
 v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
  v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
   φu = 1.5419151E-005
Mu = 4.4919E+008

---

with full section properties:
   b = 250.00
   d = 507.00
   d' = 43.00
   v = 0.00389244
      N = 9867.335
   fc = 20.00
    εco (5A.5, TBDY) = 0.002
   Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: εcu = 0.01249217
         ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
      where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
      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 = 0.008
            bw = 250.00
         effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
      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 = 0.008
            bw = 250.00
         effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
         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 = 95733.333 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) = 1360.00
         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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

    ----
        s = 100.00
      fywe = 555.55
      fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
     with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
 and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102

```
      cc (5A.5, TBDY) = 0.00271051
         c  = confinement factor = 1.07105
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
      2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
      v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Mu2-
------------------------------------------------------------------------

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
------------------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
    bw = 250.00
    effective stress from (A.35), ff,e = 642.432
    ----
    fy = 0.03840724
    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 = 0.008
            bw = 250.00
        effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----
    s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
 y1 = 0.00126309
 sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
 su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Es1 = Es = 200000.00
 y2 = 0.00126309

sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
       with Es2 = Es = 200000.00
   yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
   v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
    v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80

```
      e = 1.00
    cb = 25.00
    Ktr = 3.14159
     Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00
------------------------------------------------------------------
------------------------------------------------------------------
------------------------------------------------------------------
------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955
------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)
-----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1106.371
      Vu = 1.2475615E-020
   d = 0.8*h = 440.00
   Nu = 9867.335
   Ag = 137500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
   where:
   Vs1 = 307174.877 is calculated for section web, with:
     d = 440.00
     Av = 157079.633
     fy = 444.44
     s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
     s/d = 0.22727273
   Vs2 = 139624.944 is calculated for section flange, with:
     d = 200.00
     Av = 157079.633
     fy = 444.44
     s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
     s/d = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 332592.00
     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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 326794.274
     bw = 250.00
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
```

knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
   Mu = 1106.371
   Vu = 1.2475615E-020
 d = 0.8*h = 440.00
 Nu = 9867.335
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
 where:
 Vs1 = 307174.877 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
 Vs1 is multiplied by Col1 = 1.00
   s/d = 0.22727273
 Vs2 = 139624.944 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
 Vs2 is multiplied by Col2 = 1.00
   s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 332592.00
   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 = 1.00
 dfv = d (figure 11.2, ACI 440) = 507.00
 ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
   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, = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
   Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
   Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027913
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(αfx, αfy) = 0.05053697
    where αf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      αfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      αfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00

```
            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) = 1760.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
        ---------------------------------------------------------------
            s = 100.00
          fywe = 555.55
          fce  = 20.00
        From ((5.A5), TBDY), TBDY:  cc = 0.00271051
            c = confinement factor = 1.07105
   y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
   y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
   yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
   v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
```

d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
 cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
 2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
 v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
     fx = 0.03840724
    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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
  u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
   s = 100.00
  fywe = 555.55
  fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
= 1

db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
cb = 25.00
Ktr = 3.14159
 Atr = Min(Atr_x,Atr_y) = 157.0796
 where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
 s = 100.00
 n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
 b = 250.00
 d = 707.00
 d' = 43.00
 v = 0.00279133
  N = 9867.335
 fc = 20.00
 εco (5A.5, TBDY) = 0.002
 Final value of εcu: $\varepsilon cu^* = shear\_factor * Max(\varepsilon cu, \varepsilon cc) = 0.01249217$
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: εcu = 0.01249217
   ωwe ((5.4c), TBDY) = $\alpha se*\rho sh,min*fywe/fce+Min(\omega fx, \omega fy)$ = 0.05053697
  where $\omega f = \alpha f*\rho f*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

   ωfx = 0.03840724
  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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   ωfy = 0.03840724
  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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
   fu,f = 840.00
   Ef = 82000.00
   $\varepsilon u,f$ = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----
   s = 100.00
   fywe = 555.55
   fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607

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 = 303.142
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
 b = 250.00
 d = 707.00
 d' = 43.00

v = 0.00279133
   N = 9867.335
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
   where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
      fx = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432
   ----
      fy = 0.03840724
   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 = 0.008
         bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
         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 = 95733.333 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) = 1360.00
         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) = 1760.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 262500.00
   ----
         s = 100.00
       fywe = 555.55
       fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.00271051
         c = confinement factor = 1.07105
   y1 = 0.00126309

sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
  v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied

```
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006
------------------------------------------------------------
Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 0.61124127
    Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
    bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
    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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.4290E+007
Shear Force, V2 = -4719.14
Shear Force, V3 = 106.0256
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
         -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.005693
  u =   y +   p = 0.00612151

- Calculation of y -
----
y = (My*Ls/3)/EIeff = 0.00612151 ((4.29),Biskinis Phd))
My = 3.5105E+008
Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 3028.132
From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.7884E+013
   factor = 0.30
      Ag = 262500.00
      fc' = 20.00
      N = 10332.611
   Ec*Ig = 1.9295E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
y = Min(y_ten, y_com)
y_ten = 2.9883804E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
   d = 707.00
    y = 0.33402563
   A = 0.02935745
   B = 0.01566904
   with pt = 0.00696749
      pc = 0.00696749
      pv = 0.01521473
      N = 10332.611
      b = 250.00
       " = 0.06082037
y_comp = 7.3563789E-006
with fc* (12.3, (ACI 440)) = 20.20861
   fc = 20.00
   fl = 0.70533557
   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) = 1.00
   effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.009
   Ef = 82000.00
   Ec = 21019.039
    y = 0.33274584
   A = 0.02898082
   B = 0.01546131
    with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 444.44
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00

```
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00


---------------------------------------------------------------
 - 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 = 0.56949066
   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 = 10332.611
    Ag = 262500.00
    f'cE = 20.00
    fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
  b = 250.00
  d = 707.00
    f'cE = 20.00
---------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (a)


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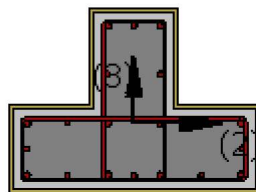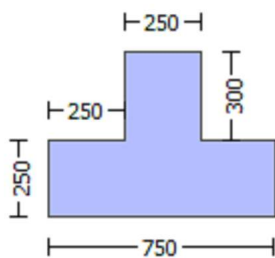```

## Calculation No. 5

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of  y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.4290E+007

Shear Force, Va = -4719.14
EDGE -B-
Bending Moment, Mb = 129045.796
Shear Force, Vb = 4719.14
BOTH EDGES
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 1231.504
  -Compression: Asl,com = 1231.504
    -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60
-------------------------------------------------------------
-------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = *Vn = 511595.873
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 550103.09
  VCol = 550103.09
  knl = 1.00
    displacement_ductility_demand = 0.06206193
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 129045.796
    Vu = 4719.14
  d = 0.8*h = 600.00
  Nu = 10332.611
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
  where:
  Vs1 = 125663.706 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.50
  Vs2 = 376991.118 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs2 is multiplied by Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 398582.298

bw = 250.00

---

displacement_ductility_demand is calculated as θ / θy

- Calculation of θ / θy for END B -
for rotation axis 3 and integ. section (b)

---

From analysis, chord rotation θ = 3.7638308E-005
θy = (My*Ls/3)/Eleff = 0.00060646 ((4.29),Biskinis Phd))
My = 3.5105E+008
Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 300.00
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.7884E+013
factor = 0.30
Ag = 262500.00
fc' = 20.00
N = 10332.611
Ec*Ig = 1.9295E+014

---
---

Calculation of Yielding Moment My

---

Calculation of φy and My according to Annex 7 -

---

φy = Min( φy_ten, φy_com)
φy_ten = 2.9883804E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
d = 707.00
ξy = 0.33402563
A = 0.02935745
B = 0.01566904
with pt = 0.00696749
pc = 0.00696749
pv = 0.01521473
N = 10332.611
b = 250.00
δ" = 0.06082037
φy_comp = 7.3563789E-006
with fc* (12.3, (ACI 440)) = 20.20861
fc = 20.00
fl = 0.70533557
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) = 1.00
effective strain from (12.5) and (12.12), efe = 0.004
εfu = 0.009
Ef = 82000.00
Ec = 21019.039
ξy = 0.33274584
A = 0.02898082
B = 0.01546131
with Es = 200000.00

---
---

Calculation of ratio lb/ld

---

Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
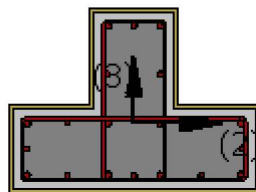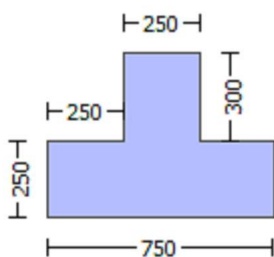    = 1
  db = 18.00
  Mean strength value of all re-bars: fy =  444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
-----------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
```

Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
  Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
  Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
 b = 250.00
 d = 507.00
 d' = 43.00
 ν = 0.00389244
  N = 9867.335
 fc = 20.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
     ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

     ωfx = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432

     ωfy = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       fu,f = 840.00
       Ef = 82000.00
        εu,f = 0.015
       αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
          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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
-----------------------------------------------------------------
        s = 100.00
      fywe = 555.55
      fce  = 20.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
  y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
  yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
```

v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
    v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----

fx = 0.03840724
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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
     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) = 1760.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 262500.00
   ----
    s = 100.00
   fywe = 555.55
   fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
 y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
   with Es1 = Es = 200000.00
 y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
    with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
    with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
 v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
    v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
      = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 555.55
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu2+
-----------------------------------------------------------------------

-----------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 1.5419151E-005
Mu = 4.4919E+008
-----------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 507.00
   d' = 43.00
   v = 0.00389244
     N = 9867.335
   fc = 20.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
     where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     --------------------------------------------------------------------
       fx = 0.03840724
     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 = 0.008
          bw = 250.00
        effective stress from (A.35), ff,e = 642.432
     --------------------------------------------------------------------
       fy = 0.03840724
     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 = 0.008
          bw = 250.00
        effective stress from (A.35), ff,e = 642.432
     --------------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       fu,f = 840.00
       Ef = 82000.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
          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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
    s = 100.00
    fywe = 555.55
    fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00

lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
 v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
 u = su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
 cb = 25.00
 Ktr = 3.14159
 Atr = Min(Atr_x,Atr_y) = 157.0796
 where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
 s = 100.00
 n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
 b = 750.00
 d = 507.00

d' = 43.00
v = 0.00129748
  N = 9867.335
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.01249217$
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01249217
    we ((5.4c), TBDY) = $ase* \rho sh,min*fywe/fce + Min(\rho fx, \rho fy) = 0.05053697$
  where $\rho f = af*pf*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

    $\rho fx = 0.03840724$
  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 = 0.008
      bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    $\rho fy = 0.03840724$
  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 = 0.008
      bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    ----
    s = 100.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105

y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
b = 690.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
  c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955

Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 1106.371
     Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
  where:
  Vs1 = 307174.877 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
   s/d = 0.22727273
  Vs2 = 139624.944 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
   s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
   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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
   bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
    Mu = 1106.371
    Vu = 1.2475615E-020
 d = 0.8*h = 440.00
 Nu = 9867.335
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
 where:
 Vs1 = 307174.877 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
 Vs1 is multiplied by Col1 = 1.00
    s/d = 0.22727273
 Vs2 = 139624.944 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
 Vs2 is multiplied by Col2 = 1.00
    s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 326794.274
     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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
    Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
    Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01249217
       ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
     where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ωfx = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432

       ωfy = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
        fu,f = 840.00
        Ef = 82000.00
         εu,f = 0.015
        αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528

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 = 95733.333 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) = 1360.00
 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) = 1760.00
 Astir (stirrups area) = 78.53982
 Asec (section area) = 262500.00

 ----
 s = 100.00
 fywe = 555.55
 fce = 20.00
 From ((5.A5), TBDY), TBDY: cc = 0.00271051
 c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.28841607
 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 = 303.142
 with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/lb,min = 0.28841607
 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 = 303.142
 with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
   2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
   v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----

with full section properties:

  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027913
   N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+ Min(fx, fy) = 0.05053697
    where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
     fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ----
     fy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
     fu,f = 840.00
     Ef = 82000.00
      u,f = 0.015
     ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    ----
     s = 100.00
    fywe = 555.55

fce = 20.00
     From ((5.A.5), TBDY), TBDY: cc = 0.00271051
          c = confinement factor = 1.07105
    y1 = 0.00126309
    sh1 = 0.00436529
   ft1 = 363.7704
   fy1 = 303.142
     su1 = 0.00467518
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.28841607
        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 = 303.142
        with Es1 = Es = 200000.00
    y2 = 0.00126309
    sh2 = 0.00436529
   ft2 = 363.7704
   fy2 = 303.142
     su2 = 0.00467518
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 0.28841607
        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 = 303.142
        with Es2 = Es = 200000.00
    yv = 0.00126309
    shv = 0.00436529
   ftv = 363.7704
   fyv = 303.142
     suv = 0.00467518
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.28841607
        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 = 303.142
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
    v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)

```
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Calculation of Mu2+
-------------------------------------------------------------------------

-------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
-------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027933
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ------------------------------------------------------------
       fx = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432
     ------------------------------------------------------------
       fy = 0.03840724
     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 = 0.008
      bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
    u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
----
     s = 100.00
    fywe = 555.55
    fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.00271051
      c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.28841607
  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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
  suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
  c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
cb = 25.00
Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis

```
    s = 100.00
    n = 20.00
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Mu2-
-----------------------------------------------------------------------

-----------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
-----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ------------------------------------------------------------------
       fx = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432
     ------------------------------------------------------------------
       fy = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432
     ------------------------------------------------------------------
       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       fu,f = 840.00
       Ef = 82000.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
          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 = 95733.333 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) = 1360.00
            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) = 1760.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
        ---------------------------------------------------------------------
            s = 100.00
         fywe = 555.55
          fce  = 20.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00271051
          c = confinement factor = 1.07105
   y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
      with Es1 = Es = 200000.00
   y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
      with Es2 = Es = 200000.00
   yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
```

v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214

Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)

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

     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:

```
        d = 200.00
        Av = 157079.633
        fy = 444.44
        s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
        s/d = 0.50
   Vs2 = 418874.832 is calculated for section flange, with:
        d = 600.00
        Av = 157079.633
        fy = 444.44
        s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
        s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 463792.00
        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 = 1.00
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 328.00
      Ef = 82000.00
       fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.009
    From (11-11), ACI 440: Vs + Vf < = 445628.556
       bw = 250.00
------------------------------------------------------------
-------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 614701.214
   knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 0.61124127
      Vu = 7.6388586E-037
   d = 0.8*h = 600.00
   Nu = 9867.335
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
   where:
   Vs1 = 139624.944 is calculated for section web, with:
      d = 200.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.50
   Vs2 = 418874.832 is calculated for section flange, with:
      d = 600.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 463792.00
      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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf < = 445628.556
   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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -111229.264
Shear Force, V2 = 4719.14

Shear Force, V3 = -106.0256
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
   -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2261.947
   -Compression: Asl,com = 829.3805
      -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = \phi * \theta u = 0.0031504$
 $\theta u = \theta y + \theta p = 0.00338753$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.00338753$ ((4.29),Biskinis Phd))
 My = 3.4149E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1049.079
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.5251E+013
    factor = 0.30
       Ag = 262500.00
       fc' = 20.00
       N = 10332.611
    Ec*Ig = 1.1750E+014

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

 $\theta y = Min(\theta y\_ten, \theta y\_com)$
 $\theta y\_ten = 4.8877902E-006$
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
    d = 507.00
     $\xi y = 0.43220405$
    A = 0.0409383
    B = 0.02750961
     with pt = 0.01784573
        pc = 0.00654344
        pv = 0.01625945
        N = 10332.611
        b = 250.00
         " = 0.08481262
 $\theta y\_comp = 7.9064364E-006$
 with fc* (12.3, (ACI 440)) = 20.19686
    fc = 20.00
    fl = 0.70533557
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
       g = pt + pc + pv = 0.04064862
    rc = 40.00
    Ae/Ac = 0.16554652
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
   effective strain from (12.5) and (12.12), efe = 0.004
    $\epsilon fu = 0.009$
   Ef = 82000.00
   Ec = 21019.039
    $\xi y = 0.43147412$
   A = 0.04041295
   B = 0.02721993

with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
   = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

 - 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 = 0.66355027
  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 = 10332.611
   Ag = 262500.00
   f'cE = 20.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.04064862
  b = 250.00
  d = 507.00
   f'cE = 20.00

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

Calculation No. 7

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00

Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -206128.725
Shear Force, Va = 106.0256
EDGE -B-
Bending Moment, Mb = -111229.264
Shear Force, Vb = -106.0256
BOTH EDGES
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
      -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 358938.592
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 385955.475
  VCol = 385955.475
  knl = 1.00
    displacement_ductility_demand = 1.9061487E-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' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.38427
    Mu = 111229.264
    Vu = 106.0256
  d = 0.8*h = 440.00
  Nu = 10332.611
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 402123.86
  where:
  Vs1 = 276460.154 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 125663.706 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs2 is multiplied by Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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: $\theta_1 = b_1 + 90° = 90.00$
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 292293.685
   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 = 6.4571276E-009
 y = (My*Ls/3)/EIeff = 0.00338753 ((4.29),Biskinis Phd))
 My = 3.4149E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1049.079
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.5251E+013
   factor = 0.30
     Ag = 262500.00
     fc' = 20.00
     N = 10332.611
   Ec*Ig = 1.1750E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
 y = Min(y_ten, y_com)
 y_ten = 4.8877902E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
   d = 507.00
    y = 0.43220405
   A = 0.0409383
   B = 0.02750961
    with pt = 0.01784573
       pc = 0.00654344
       pv = 0.01625945
       N = 10332.611
       b = 250.00
        " = 0.08481262
 y_comp = 7.9064364E-006
 with fc* (12.3, (ACI 440)) = 20.19686
   fc = 20.00
   fl = 0.70533557
   b = bmax = 750.00
   h = hmax = 550.00
   Ag = 262500.00
      g = pt + pc + pv = 0.04064862
   rc = 40.00
   Ae/Ac = 0.16554652
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  effective strain from (12.5) and (12.12), efe = 0.004
   fu = 0.009
  Ef = 82000.00
  Ec = 21019.039

```
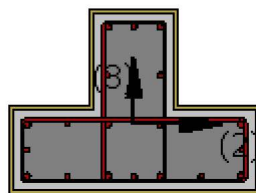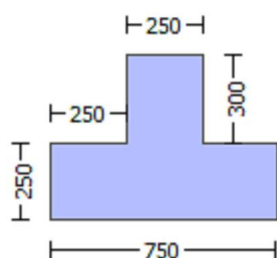     y = 0.43147412
     A = 0.04041295
     B = 0.02721993
      with Es = 200000.00
-------------------------------------------------------------
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 444.44
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
-------------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-

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Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
   Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
   Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  ν = 0.00389244
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu^* = shear_factor * Max(εcu, εcc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01249217
       ωwe ((5.4c), TBDY) = $\alpha ase^* \rho sh,min*fywe/fce+Min(\omega fx, \omega fy)$ = 0.05053697
     where $\omega f = \alpha f*\rho f*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ωfx = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432

       ωfy = 0.03840724
     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 = 0.008
    bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

----

s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
b = 190.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
= 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.1097366E-005
Mu = 2.2828E+008
----

with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  ν = 0.00129748
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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

```
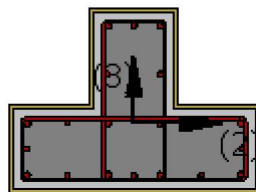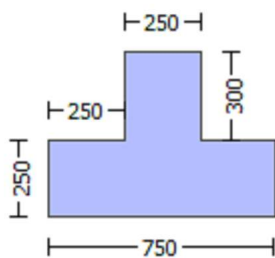        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
     ----------------------------------------------------------------
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00526591
        Lstir (Length of stirrups along X) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
     ----------------------------------------------------------------
        s = 100.00
      fywe = 555.55
      fce  = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00271051
        c  = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
     with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
```

```
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
    v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =   su (4.1) = 1.1097366E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
------------------------------------------------------------------------
------------------------------------------------------------------------
------------------------------------------------------------------------
Calculation of Mu2+
------------------------------------------------------------------------

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.5419151E-005
Mu = 4.4919E+008
------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244
   N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ------------------------------------------------------------------
      fx = 0.03840724
     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 = 0.008
   bw = 250.00
effective stress from (A.35), ff,e = 642.432
----
fy = 0.03840724
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 = 0.008
      bw = 250.00
   effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
   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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142

with Es1 = Es = 200000.00
    y2 = 0.00126309
    sh2 = 0.00436529
   ft2 = 363.7704
   fy2 = 303.142
    su2 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
    yv = 0.00126309
    shv = 0.00436529
   ftv = 363.7704
   fyv = 303.142
    suv = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
   b = 190.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
       c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
    v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00

Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 t = 1.00
 s = 0.80
 e = 1.00
cb = 25.00
Ktr = 3.14159
 Atr = Min(Atr_x,Atr_y) = 157.0796
 where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
 s = 100.00
 n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature ϕu according to 4.1, Biskinis/Fardis 2013:
 ϕu = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
 b = 750.00
 d = 507.00
 d' = 43.00
 v = 0.00129748
  N = 9867.335
 fc = 20.00
 εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: εcu = 0.01249217
   ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
  where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

   ωfx = 0.03840724
  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), ρf = 2tf/bw = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   ωfy = 0.03840724
  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), ρf = 2tf/bw = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
   fu,f = 840.00
   Ef = 82000.00
   εu,f = 0.015
   αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
    s = 100.00
    fywe = 555.55
    fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
b = 690.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
u = su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955

Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
VCol0 = 451299.955
knl = 1 (zero step-static loading)

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

 = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 2.00
Mu = 1106.371

```
    Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
  where:
  Vs1 = 307174.877 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 139624.944 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 326794.274
    bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
   = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
    Mu = 1106.371
    Vu = 1.2475615E-020
 d = 0.8*h = 440.00
 Nu = 9867.335
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
 where:
 Vs1 = 307174.877 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
 Vs1 is multiplied by   Col1 = 1.00
   s/d = 0.22727273
 Vs2 = 139624.944 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
```

fy = 444.44
       s = 100.00
    Vs2 is multiplied by   Col2 = 1.00
       s/d = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 332592.00
     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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
       with fu = 0.009
   From (11-11), ACI 440: Vs + Vf < = 326794.274
     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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
###
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00

Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
   Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
   Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027933
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----
       fx = 0.03840724

119.

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 = 0.008

     bw = 250.00

   effective stress from (A.35), ff,e = 642.432

----

  fy = 0.03840724

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 = 0.008

     bw = 250.00

   effective stress from (A.35), ff,e = 642.432

  R = 40.00

  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00

  fu,f = 840.00

  Ef = 82000.00

  u,f = 0.015

  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528

    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 = 95733.333 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) = 1360.00

    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) = 1760.00

    Astir (stirrups area) = 78.53982

    Asec (section area) = 262500.00

----

   s = 100.00

  fywe = 555.55

  fce = 20.00

 From ((5.A5), TBDY), TBDY: cc = 0.00271051

   c = confinement factor = 1.07105

y1 = 0.00126309

sh1 = 0.00436529

ft1 = 363.7704

fy1 = 303.142

su1 = 0.00467518

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

  and also multiplied by the shear_factor according to 15.7.1.4, with

  Shear_factor = 1.00

  lo/lou,min = lb/ld = 0.28841607

  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 = 303.142
        with Es1 = Es = 200000.00
   y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
        with Es2 = Es = 200000.00
   yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
        with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
   v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
   N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
    fx = 0.03840724
    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 = 0.008
      bw = 250.00
     effective stress from (A.35), ff,e = 642.432
    ----
    fy = 0.03840724
    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 = 0.008
      bw = 250.00
     effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
    u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
     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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
b = 250.00

d = 707.00
d' = 43.00
v = 0.00279133
  N = 9867.335
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01249217
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
  where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  ----
    fx = 0.03840724
  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 = 0.008
      bw = 250.00
    effective stress from (A.35), ff,e = 642.432
  ----
    fy = 0.03840724
  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 = 0.008
      bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
  ----
      s = 100.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051

```
        c  = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
       with Es1 = Es = 200000.00
    y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
       with Es2 = Es = 200000.00
    yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
    v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
       c  = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
```

```
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006
 -------------------------------------------------------------

Calculation of ratio lb/ld
 -------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
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 ----------------------------------------------------------------------
Calculation of Mu2-
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Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
 ----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    --------------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    --------------------------------------------------------------------
      fy = 0.03840724
    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 = 0.008
    bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
  v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

```
------------------------------------------------------------------------
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------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 614701.214
   knl = 1 (zero step-static loading)
   ----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
   ----------------------------------------------------------------
      = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 0.61124127
      Vu = 7.6388586E-037
   d = 0.8*h = 600.00
   Nu = 9867.335
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
   where:
   Vs1 = 139624.944 is calculated for section web, with:
      d = 200.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.50
   Vs2 = 418874.832 is calculated for section flange, with:
      d = 600.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 463792.00
      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 = 1.00
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 328.00
      Ef = 82000.00
       fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 445628.556
      bw = 250.00
   ----------------------------------------------------------------
------------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 614701.214
   knl = 1 (zero step-static loading)
   ----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
   ----------------------------------------------------------------
      = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
```

M/Vd = 2.00
   Mu = 0.61124127
   Vu = 7.6388586E-037
d = 0.8*h = 600.00
Nu = 9867.335
Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
where:
Vs1 = 139624.944 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.50
Vs2 = 418874.832 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 463792.00
  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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.009
From (11-11), ACI 440: Vs + Vf <= 445628.556
  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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00

Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 129045.796
Shear Force, V2 = 4719.14
Shear Force, V3 = -106.0256
Axial Force, F = -10332.611
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
      -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
      -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = \theta^* \theta u = 0.00056401$
 $\theta u = \theta y + \theta p = 0.00060646$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.00060646$ ((4.29),Biskinis Phd))
  My = 3.5105E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 300.00
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.7884E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 20.00
        N = 10332.611
     Ec*Ig = 1.9295E+014

Calculation of Yielding Moment My

Calculation of φy and My according to Annex 7 -

 $\varphi y = Min(\varphi y\_ten, \varphi y\_com)$
 $\varphi y\_ten = 2.9883804E-006$
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 707.00
     ξy = 0.33402563
     A = 0.02935745

```
        B = 0.01566904
          with pt = 0.00696749
              pc = 0.00696749
              pv = 0.01521473
              N = 10332.611
              b = 250.00
              " = 0.06082037
     y_comp = 7.3563789E-006
   with fc* (12.3, (ACI 440)) = 20.20861
        fc = 20.00
        fl = 0.70533557
        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) = 1.00
        effective strain from (12.5) and (12.12), efe = 0.004
          fu = 0.009
        Ef = 82000.00
        Ec = 21019.039
          y = 0.33274584
        A = 0.02898082
        B = 0.01546131
          with Es = 200000.00
-------------------------------------------------------------
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
      = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 444.44
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      t = 1.00
      s = 0.80
      e = 1.00
   cb = 25.00
   Ktr = 3.14159
     Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00


-------------------------------------------------------------
 - 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 = 0.56949066
   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 = 10332.611
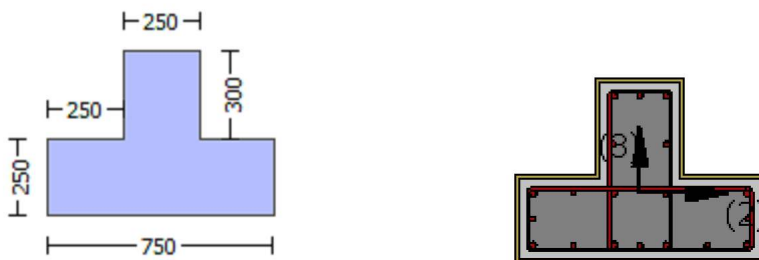     Ag = 262500.00
     f'cE = 20.00
```

```
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
   b = 250.00
   d = 707.00
   f'cE = 20.00
------------------------------------------------------------
```
End Of Calculation of Chord Rotation Capacity for element: column TC1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00

```
############################################################
Note: Especially for the calculation of  y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
############################################################
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.1864E+007
Shear Force, Va = -3917.97
EDGE -B-
Bending Moment, Mb = 107137.548
Shear Force, Vb = 3917.97
BOTH EDGES
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
     -Compression: Asl,com = 1231.504
         -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60
-----------------------------------------------------------
-----------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 441131.458
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 474334.901
   VCol = 474334.901
   knl = 1.00
      displacement_ductility_demand = 0.0141231
-----------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
```

Mu = 1.1864E+007
Vu = 3917.97
d = 0.8*h = 600.00
Nu = 10253.621
Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
where:
Vs1 = 125663.706 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 400.00
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.50
Vs2 = 376991.118 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 400.00
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 463792.00
  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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
   εfe = 0.004, from (11.6a), ACI 440
     with εfu = 0.009
From (11-11), ACI 440: Vs + Vf <= 398582.298
  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   = 8.6449823E-005
 y = (My*Ls/3)/Eieff = 0.00612116 ((4.29),Biskinis Phd))
  My = 3.5103E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 3028.132
  From table 10.5, ASCE 41_17: Eieff = factor*Ec*Ig = 5.7884E+013
   factor = 0.30
     Ag = 262500.00
     fc' = 20.00
     N = 10253.621
   Ec*Ig = 1.9295E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
 y = Min(y_ten, y_com)
 y_ten = 2.9883067E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
   d = 707.00

```
      y = 0.33400922
     A = 0.02935586
     B = 0.01566745
      with pt = 0.00696749
          pc = 0.00696749
          pv = 0.01521473
          N = 10253.621
          b = 250.00
          " = 0.06082037
   y_comp = 7.3565275E-006
 with fc* (12.3, (ACI 440)) = 20.20861
     fc = 20.00
     fl = 0.70533557
     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) = 1.00
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.009
     Ef = 82000.00
    Ec = 21019.039
     y = 0.33273912
     A = 0.02898211
     B = 0.01546131
      with Es = 200000.00
-------------------------------------------------------------
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00
-------------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00

Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
   Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
   Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----
       fx = 0.03840724
     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 = 0.008
    bw = 250.00
  effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
    bw = 250.00
  effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    ----
      s = 100.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
      c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
b = 190.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
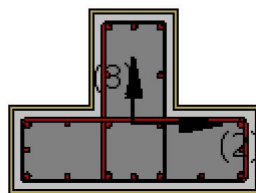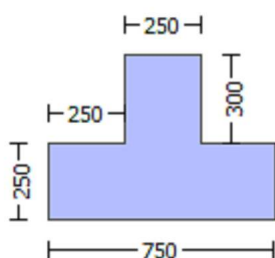        = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 555.55
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
     Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00
```


Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
   b = 750.00
   d = 507.00
   d' = 43.00
   v = 0.00129748
      N = 9867.335
   fc = 20.00
     co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01249217
        we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----
        fx = 0.03840724
      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 = 0.008
            bw = 250.00
         effective stress from (A.35), ff,e = 642.432
      ----
        fy = 0.03840724
      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 = 0.008
            bw = 250.00
         effective stress from (A.35), ff,e = 642.432

         R = 40.00
         Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
         fu,f = 840.00
         Ef = 82000.00
          u,f = 0.015
         ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
            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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.28841607
   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 ɣyv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 ɣy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 303.142
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
  v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u = su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
 b = 250.00
 d = 507.00
 d' = 43.00
 v = 0.00389244

N = 9867.335
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
    where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----

    fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ----

    fy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
    u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    ----

      s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
      c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529

ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
     with Es1 = Es = 200000.00
 y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
     with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
   v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->

φsu (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
φu = φsu (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    ψ = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    ψt = 1.00
    ψs = 0.80
    ψe = 1.00
  cb = 25.00
  Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00

effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

----

s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY, TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
   with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
 v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
 b = 690.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
  v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955

```
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 1106.371
     Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
  where:
  Vs1 = 307174.877 is calculated for section web, with:
     d = 440.00
     Av = 157079.633
     fy = 444.44
     s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
     s/d = 0.22727273
  Vs2 = 139624.944 is calculated for section flange, with:
     d = 200.00
     Av = 157079.633
     fy = 444.44
     s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
     s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
     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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 507.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
       with   fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 326794.274
     bw = 250.00
--------------------------------------------------------------

--------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 1106.371
     Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
```

Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
where:
Vs1 = 307174.877 is calculated for section web, with:
  d = 440.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.22727273
Vs2 = 139624.944 is calculated for section flange, with:
  d = 200.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 332592.00
  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: α_1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, α_1)|, |Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
  εfe = 0.004, from (11.6a), ACI 440
    with εfu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
  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, = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00

Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
   Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
   Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00

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d = 707.00
d' = 43.00
ν = 0.00279133
N = 9867.335
fc = 20.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.01249217
we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
fx = 0.03840724
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 = 0.008
bw = 250.00
effective stress from (A.35), ff,e = 642.432
----
fy = 0.03840724
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 = 0.008
bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051

```
          c  = confinement factor = 1.07105
     y1 = 0.00126309
    sh1 = 0.00436529
   ft1 = 363.7704
   fy1 = 303.142
    su1 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
     y2 = 0.00126309
    sh2 = 0.00436529
   ft2 = 363.7704
   fy2 = 303.142
    su2 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
     yv = 0.00126309
    shv = 0.00436529
   ftv = 363.7704
   fyv = 303.142
    suv = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
     2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
     v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
       c  = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
     2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
     v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
```

```
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 555.55
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
     s = 100.00
     n = 20.00
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
--------------------------------------------------------------------
with full section properties:
   b = 250.00
   d = 707.00
   d' = 43.00
   v = 0.00279133
     N = 9867.335
   fc = 20.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,   fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
      fx = 0.03840724
     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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432
     ----------------------------------------------------------------
      fy = 0.03840724
     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 = 0.008
    bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.0507052E-006
Mu = 5.2510E+008
----

with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027913
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:

```
   b = 190.00
   d = 677.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
     cc (5A.5, TBDY) = 0.00271051
        c = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
     2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
     v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =    su (4.1) = 9.0507052E-006
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Mu2-
----------------------------------------------------------------------

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432
----
    fy = 0.03840724
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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----
        s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
   with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
   with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
  v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
---------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
     Ef = 82000.00
      fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
```

bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 614701.214

Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0

  VCol0 = 614701.214

  knl = 1 (zero step-static loading)

NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'

where Vf is the contribution of FRPs (11.3), ACI 440).

    = 1 (normal-weight concrete)

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

 M/Vd = 2.00

   Mu = 0.61124127

   Vu = 7.6388586E-037

 d = 0.8*h = 600.00

 Nu = 9867.335

 Ag = 187500.00

 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776

 where:

 Vs1 = 139624.944 is calculated for section web, with:

   d = 200.00

   Av = 157079.633

   fy = 444.44

   s = 100.00

 Vs1 is multiplied by   Col1 = 1.00

   s/d = 0.50

 Vs2 = 418874.832 is calculated for section flange, with:

   d = 600.00

   Av = 157079.633

   fy = 444.44

   s = 100.00

 Vs2 is multiplied by   Col2 = 1.00

   s/d = 0.16666667

 Vf ((11-3)-(11.4), ACI 440) = 463792.00

   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 = 1.00

 dfv = d (figure 11.2, ACI 440) = 707.00

 ffe ((11-5), ACI 440) = 328.00

   Ef = 82000.00

    fe = 0.004, from (11.6a), ACI 440

     with fu = 0.009

 From (11-11), ACI 440: Vs + Vf <= 445628.556

   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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, $fc = fcm = 20.00$
Existing material of Secondary Member: Steel Strength, $fs = fsm = 444.44$
Concrete Elasticity, $Ec = 21019.039$
Steel Elasticity, $Es = 200000.00$
Max Height, $Hmax = 550.00$
Min Height, $Hmin = 250.00$
Max Width, $Wmax = 750.00$
Min Width, $Wmin = 250.00$
Eccentricity, $Ecc = 250.00$
Cover Thickness, $c = 25.00$
Element Length, $L = 3000.00$
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length $lb = 300.00$
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, $t = 1.00$
Tensile Strength, $ffu = 840.00$
Tensile Modulus, $Ef = 82000.00$
Elongation, $efu = 0.009$
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, $M = -171322.016$
Shear Force, $V2 = -3917.97$
Shear Force, $V3 = 88.02562$
Axial Force, $F = -10253.621$
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: $Aslt = 0.00$
    -Compression: $Aslc = 5152.212$
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: $Asl,ten = 2261.947$
    -Compression: $Asl,com = 829.3805$
    -Middle: $Asl,mid = 2060.885$
Mean Diameter of Tension Reinforcement, $DbL = 17.77778$

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u,R = * u = 0.04490446$
$u = y + p = 0.04828437$

- Calculation of y -

$y = (My*Ls/3)/EIeff = 0.00628437$ ((4.29),Biskinis Phd))
  $My = 3.4147E+008$
  $Ls = M/V$ (with $Ls > 0.1*L$ and $Ls < 2*L$) $= 1946.275$
  From table 10.5, ASCE 41_17: $EIeff = factor*Ec*Ig = 3.5251E+013$
    factor $= 0.30$
      $Ag = 262500.00$
      $fc' = 20.00$
      $N = 10253.621$
    $Ec*Ig = 1.1750E+014$

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

Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of  y and My according to Annex 7   -
-----------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 4.8876648E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 507.00
      y = 0.43218949
     A = 0.04093608
     B = 0.02750739
      with pt = 0.01784573
          pc = 0.00654344
          pv = 0.01625945
          N = 10253.621
          b = 250.00
           " = 0.08481262
   y_comp = 7.9066025E-006
  with fc* (12.3, (ACI 440)) = 20.19686
      fc = 20.00
      fl = 0.70533557
      b = bmax = 750.00
      h = hmax = 550.00
      Ag = 262500.00
          g = pt + pc + pv = 0.04064862
          rc = 40.00
          Ae/Ac = 0.16554652
          Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.009
     Ef = 82000.00
     Ec = 21019.039
      y = 0.43146506
     A = 0.04041476
     B = 0.02721993
      with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 444.44
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00


-----------------------------------------------------------
 - Calculation of   p -
-----------------------------------------------------------
From table 10-8:  p = 0.042
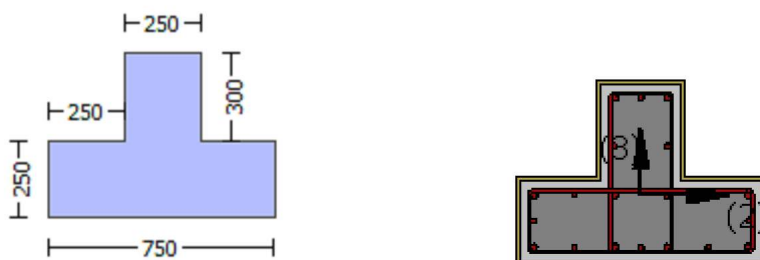with:
```

- Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VCol0E = 0.66355027
  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 = 10253.621
   Ag = 262500.00
   f'cE = 20.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.04064862
  b = 250.00
  d = 507.00
   f'cE = 20.00

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

Calculation No. 11

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -171322.016
Shear Force, Va = 88.02562
EDGE -B-
Bending Moment, Mb = -92158.008
Shear Force, Vb = -88.02562
BOTH EDGES
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2261.947
    -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = *Vn = 323746.668
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 348114.696
　VCol = 348114.696
　knl = 1.00
　　displacement_ductility_demand = 0.00272095

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

　　= 1 (normal-weight concrete)
　fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
　M/Vd = 4.00
　　Mu = 171322.016
　　Vu = 88.02562
　d = 0.8*h = 440.00
　Nu = 10253.621
　Ag = 137500.00
　From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 402123.86
　where:
　Vs1 = 276460.154 is calculated for section web, with:
　　d = 440.00
　　Av = 157079.633
　　fy = 400.00
　　s = 100.00
　Vs1 is multiplied by Col1 = 1.00
　　s/d = 0.22727273
　Vs2 = 125663.706 is calculated for section flange, with:
　　d = 200.00
　　Av = 157079.633
　　fy = 400.00
　　s = 100.00
　Vs2 is multiplied by Col2 = 1.00
　　s/d = 0.50
　Vf ((11-3)-(11.4), ACI 440) = 332592.00
　　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 = 1.00
　dfv = d (figure 11.2, ACI 440) = 507.00
　ffe ((11-5), ACI 440) = 328.00
　　Ef = 82000.00
　　fe = 0.004, from (11.6a), ACI 440
　　　with fu = 0.009
　From (11-11), ACI 440: Vs + Vf <= 292293.685
　　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 = 1.7099420E-005
 y = (My*Ls/3)/EIeff = 0.00628437 ((4.29),Biskinis Phd))
　My = 3.4147E+008
　Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1946.275
　From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.5251E+013
　　factor = 0.30
　　　Ag = 262500.00
　　　fc' = 20.00

```
        N = 10253.621
     Ec*Ig = 1.1750E+014
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of   y and My according to Annex 7   -
--------------------------------------------------------------
  y = Min(  y_ten,  y_com)
  y_ten = 4.8876648E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 507.00
      y = 0.43218949
     A = 0.04093608
     B = 0.02750739
      with pt = 0.01784573
          pc = 0.00654344
          pv = 0.01625945
          N = 10253.621
          b = 250.00
          " = 0.08481262
  y_comp = 7.9066025E-006
  with fc* (12.3, (ACI 440)) = 20.19686
     fc = 20.00
     fl = 0.70533557
     b = bmax = 750.00
     h = hmax = 550.00
     Ag = 262500.00
         g = pt + pc + pv = 0.04064862
         rc = 40.00
         Ae/Ac = 0.16554652
         Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      effective strain from (12.5) and (12.12), efe = 0.004
       fu = 0.009
      Ef = 82000.00
      Ec = 21019.039
       y = 0.43146506
      A = 0.04041476
      B = 0.02721993
       with Es = 200000.00
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of ratio lb/ld
--------------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
--------------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00

Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
   Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
   Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00

v = 0.00389244
   N = 9867.335
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01249217
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
  where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
   fx = 0.03840724
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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432
----
   fy = 0.03840724
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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
   fu,f = 840.00
   Ef = 82000.00
   u,f = 0.015
   ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
   s = 100.00
   fywe = 555.55
   fce = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309

```
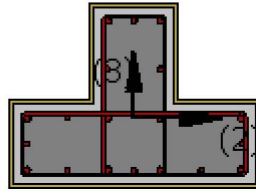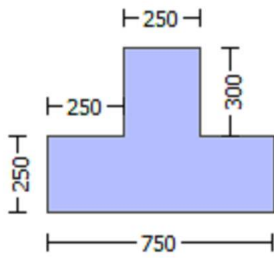    sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      su1 = 0.4*esu1_nominal ((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 = 303.142
       with Es1 = Es = 200000.00
   y2 = 0.00126309
    sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
       with Es2 = Es = 200000.00
   yv = 0.00126309
    shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
  b = 190.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c  = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
    v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
```

```
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Mu1-
----------------------------------------------------------------

----------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.1097366E-005
Mu = 2.2828E+008
----------------------------------------------------------------
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       fx = 0.03840724
     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 = 0.008
         bw = 250.00
       effective stress from (A.35), ff,e = 642.432
     ----------------------------------------------------------------
       fy = 0.03840724
     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 = 0.008
```

bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
  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 = 95733.333 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) = 1360.00
  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) = 1760.00
  Astir (stirrups area) = 78.53982
  Asec (section area) = 262500.00

----

s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
  c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
  with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
  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 = 303.142
 with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
   v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.5419151E-005
Mu = 4.4919E+008

---

with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  ν = 0.00389244
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

----

    s = 100.00
   fywe = 555.55
   fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
$y1$ = 0.00126309
$sh1$ = 0.00436529
$ft1$ = 363.7704
$fy1$ = 303.142
$su1$ = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  $su1 = 0.4*esu1\_nominal$ ((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 = 303.142
  with Es1 = Es = 200000.00
$y2$ = 0.00126309
$sh2$ = 0.00436529
$ft2$ = 363.7704
$fy2$ = 303.142
$su2$ = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
  $su2 = 0.4*esu2\_nominal$ ((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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  $suv = 0.4*esuv\_nominal$ ((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 = 303.142
  with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102

```
     cc (5A.5, TBDY) = 0.00271051
        c  = confinement factor = 1.07105
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
      2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
      v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 555.55
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Mu2-
--------------------------------------------------------------------------

--------------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
   u = 1.1097366E-005
Mu = 2.2828E+008
--------------------------------------------------------------------------
with full section properties:
   b = 750.00
   d = 507.00
   d' = 43.00
   v = 0.00129748
      N = 9867.335
   fc = 20.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      --------------------------------------------------------------
       fx = 0.03840724
      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), $pf = 2tf/bw = 0.008$
   bw = 250.00
effective stress from (A.35), $ff,e = 642.432$
----
  fy = 0.03840724
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), $pf = 2tf/bw = 0.008$
   bw = 250.00
effective stress from (A.35), $ff,e = 642.432$

  R = 40.00
Effective FRP thickness, $tf = NL*t*Cos(b1) = 1.00$
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
$ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528$
   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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----
   s = 100.00
  fywe = 555.55
  fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
 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 = 303.142
  with Es1 = Es = 200000.00
y2 = 0.00126309

```
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
      with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c  = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
   v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =    su (4.1) = 1.1097366E-005
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
```

```
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 451299.955
   knl = 1 (zero step-static loading)
-----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 1106.371
      Vu = 1.2475615E-020
   d = 0.8*h = 440.00
   Nu = 9867.335
   Ag = 137500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
   where:
   Vs1 = 307174.877 is calculated for section web, with:
      d = 440.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.22727273
   Vs2 = 139624.944 is calculated for section flange, with:
      d = 200.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 332592.00
      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 = 1.00
   dfv = d (figure 11.2, ACI 440) = 507.00
   ffe ((11-5), ACI 440) = 328.00
      Ef = 82000.00
       fe = 0.004, from (11.6a), ACI 440
         with  fu = 0.009
    From (11-11), ACI 440: Vs + Vf <= 326794.274
      bw = 250.00
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 451299.955
```

knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
    Mu = 1106.371
    Vu = 1.2475615E-020
 d = 0.8*h = 440.00
 Nu = 9867.335
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
 where:
 Vs1 = 307174.877 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
 Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
 Vs2 = 139624.944 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
 Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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 = 1.00
 dfv = d (figure 11.2, ACI 440) = 507.00
 ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
       with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
    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, = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039

Steel Elasticity, Es = 200000.00

##

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

##

Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
  Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
  Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  ν = 0.00279133
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      αωe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(φfx, φfy) = 0.05053697
    where φf = αf*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      φfx = 0.03840724
    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), pf = 2tf/bw = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      φfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      εu,f = 0.015
    αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00

```
            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) = 1760.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
     -----------------------------------------------------------------
            s = 100.00
         fywe = 555.55
         fce = 20.00
       From ((5.A5), TBDY), TBDY:  cc = 0.00271051
            c = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
    y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
    yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
     2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
     v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
```

d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432
----
    fy = 0.03840724
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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
----
    s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
= 1

db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
cb = 25.00
Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  ν = 0.00279133
    N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00

----

    s = 100.00
    fywe = 555.55
    fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607

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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
b = 190.00
d = 677.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
= 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
b = 250.00
d = 707.00
d' = 43.00

v = 0.00279133
   N = 9867.335
fc = 20.00
  εco (5A.5, TBDY) = 0.002
Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: εcu = 0.01249217
    ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
   where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

    ωfx = 0.03840724
   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 = 0.008
     bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    ωfy = 0.03840724
   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 = 0.008
     bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
    εu,f = 0.015
    αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
     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 = 95733.333 is the unconfined core area which is equal to $\sum$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) = 1360.00
     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) = 1760.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 262500.00
   ----
     s = 100.00
    fywe = 555.55
    fce = 20.00
  From ((5.A5), TBDY), TBDY: εcc = 0.00271051
    λc = confinement factor = 1.07105
y1 = 0.00126309

sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Es1 = Es = 200000.00
   y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
      with Es2 = Es = 200000.00
   yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
   v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
   2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
   v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied

```
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =    su (4.1) = 9.0507052E-006
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
--------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
-----------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 0.61124127
    Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
   fe = 0.004, from (11.6a), ACI 440
     with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 445628.556
   bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)

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

   = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 0.61124127
    Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
       with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 445628.556
    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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.1864E+007
Shear Force, V2 = -3917.97
Shear Force, V3 = 88.02562
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
    -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 1231.504
    -Compression: Asl,com = 1231.504
      -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.04475268
 u = y + p = 0.04812116

```
------------------------------------------------------------
 - Calculation of  y -
------------------------------------------------------------
 y = (My*Ls/3)/EIeff = 0.00612116 ((4.29),Biskinis Phd))
  My = 3.5103E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 3028.132
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 5.7884E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 20.00
        N = 10253.621
     Ec*Ig = 1.9295E+014
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of  y and My according to Annex 7   -
-----------------------------------------------------------
 y = Min( y_ten,  y_com)
 y_ten = 2.9883067E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
    d = 707.00
      y = 0.33400922
    A = 0.02935586
    B = 0.01566745
     with pt = 0.00696749
         pc = 0.00696749
         pv = 0.01521473
         N = 10253.621
         b = 250.00
          " = 0.06082037
 y_comp = 7.3565275E-006
 with fc* (12.3, (ACI 440)) = 20.20861
    fc = 20.00
    fl = 0.70533557
    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) = 1.00
   effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.009
   Ef = 82000.00
   Ec = 21019.039
    y = 0.33273912
   A = 0.02898211
   B = 0.01546131
    with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
```

cb = 25.00
Ktr = 3.14159
 Atr = Min(Atr_x,Atr_y) = 157.0796
 where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
 s = 100.00
 n = 20.00

 - 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 = 0.56949066
  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 = 10253.621
   Ag = 262500.00
   f'cE = 20.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
  b = 250.00
  d = 707.00
   f'cE = 20.00

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

Calculation No. 13

column C1, Floor 1

Limit State: 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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -1.1864E+007

Shear Force, Va = -3917.97
EDGE -B-
Bending Moment, Mb = 107137.548
Shear Force, Vb = 3917.97
BOTH EDGES
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
   -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 1231.504
   -Compression: Asl,com = 1231.504
     -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL,ten = 17.60

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 511581.38
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 550087.505
  VCol = 550087.505
  knl = 1.00
    displacement_ductility_demand = 0.05152854

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

     = 1 (normal-weight concrete)
  fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 107137.548
    Vu = 3917.97
  d = 0.8*h = 600.00
  Nu = 10253.621
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
  where:
  Vs1 = 125663.706 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.50
  Vs2 = 376991.118 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 398582.298

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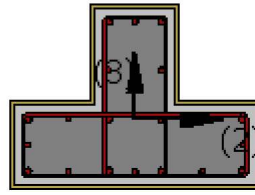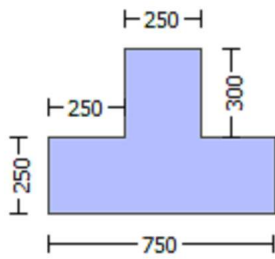        bw = 250.00
-----------------------------------------------------------


-----------------------------------------------------------
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    = 3.1248441E-005
  y = (My*Ls/3)/Eleff = 0.00060643 ((4.29),Biskinis Phd))
   My = 3.5103E+008
   Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 300.00
   From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.7884E+013
      factor = 0.30
         Ag = 262500.00
         fc' = 20.00
         N = 10253.621
      Ec*Ig = 1.9295E+014
-----------------------------------------------------------
-----------------------------------------------------------


Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of   y and My according to Annex 7   -
-----------------------------------------------------------
  y = Min(  y_ten,   y_com)
  y_ten = 2.9883067E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 707.00
      y = 0.33400922
     A = 0.02935586
     B = 0.01566745
      with pt = 0.00696749
         pc = 0.00696749
         pv = 0.01521473
         N = 10253.621
         b = 250.00
          " = 0.06082037
  y_comp = 7.3565275E-006
 with fc* (12.3, (ACI 440)) = 20.20861
     fc = 20.00
     fl = 0.70533557
     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) = 1.00
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.009
     Ef = 82000.00
    Ec = 21019.039
     y = 0.33273912
     A = 0.02898211
     B = 0.01546131
      with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------


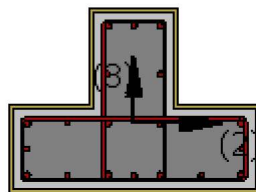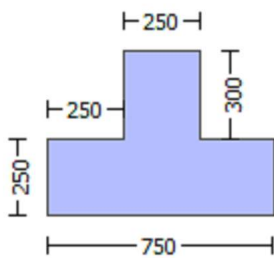Calculation of ratio lb/ld
-----------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
```

```
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
----------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column TC1 of floor 1
At local axis: 2
Integration Section: (b)


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

Calculation No. 14

column C1, Floor 1

Limit State: 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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:

Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-
Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
  Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
  Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  ν = 0.00389244
     N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01249217
        ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
     where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

        ωfx = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432

        ωfy = 0.03840724
     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 = 0.008
           bw = 250.00
        effective stress from (A.35), ff,e = 642.432

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
        fu,f = 840.00
        Ef = 82000.00
        εu,f = 0.015
        αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
           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 = 95733.333 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) = 1360.00
            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) = 1760.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 262500.00
        ----------------------------------------------------------------
            s = 100.00
        fywe = 555.55
        fce  = 20.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
  y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
  yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
```

```
       v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
   b = 190.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
     cc (5A.5, TBDY) = 0.00271051
        c = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
     v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
   u =    su (4.1) = 1.5419151E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 555.55
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      t = 1.00
      s = 0.80
      e = 1.00
   cb = 25.00
   Ktr = 3.14159
     Atr = Min(Atr_x,Atr_y) = 157.0796
     where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
      s = 100.00
      n = 20.00
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Mu1-
--------------------------------------------------------------------------

--------------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
   u = 1.1097366E-005
Mu = 2.2828E+008
--------------------------------------------------------------------------
with full section properties:
   b = 750.00
   d = 507.00
   d' = 43.00
   v = 0.00129748
      N = 9867.335
   fc = 20.00
     co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01249217
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05053697
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      --------------------------------------------------------------------
```

fx = 0.03840724
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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432
----
fy = 0.03840724
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 = 0.008
        bw = 250.00
    effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
u,f = 0.015
ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----
    s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
  with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
  b = 690.00
  d = 477.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
    v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
 u =   su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

```
      = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
```


Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432
    ----
      fy = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       fu,f = 840.00
       Ef = 82000.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
          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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.28841607
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 = 303.142
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
 v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
 u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
 b = 750.00
 d = 507.00

d' = 43.00
v = 0.00129748
    N = 9867.335
fc = 20.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ----
      fy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
         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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00
    ----
        s = 100.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
       c = confinement factor = 1.07105

```
   y1 = 0.00126309
   sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
   su1 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
   y2 = 0.00126309
   sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
   su2 = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
   yv = 0.00126309
   shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
   suv = 0.00467518
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
     2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
     v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
   b = 690.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
     cc (5A.5, TBDY) = 0.00271051
        c  = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
     2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
     v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
```

```
  su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =    su (4.1) = 1.1097366E-005
----------------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955
----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)
----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
----------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 1106.371
     Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
  where:
  Vs1 = 307174.877 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
   s/d = 0.22727273
  Vs2 = 139624.944 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
   s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
   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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.009
 From (11-11), ACI 440: Vs + Vf <= 326794.274
    bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 2.00
    Mu = 1106.371
    Vu = 1.2475615E-020
 d = 0.8*h = 440.00
 Nu = 9867.335
 Ag = 137500.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
 where:
 Vs1 = 307174.877 is calculated for section web, with:
   d = 440.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
 Vs1 is multiplied by Col1 = 1.00
   s/d = 0.22727273
 Vs2 = 139624.944 is calculated for section flange, with:
   d = 200.00
   Av = 157079.633
   fy = 444.44
   s = 100.00
 Vs2 is multiplied by Col2 = 1.00
   s/d = 0.50
 Vf ((11-3)-(11.4), ACI 440) = 332592.00
   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 = 1.00
 dfv = d (figure 11.2, ACI 440) = 507.00
 ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
     fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 326794.274
    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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
  Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
  Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
  N = 9867.335
  fc = 20.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu^* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = $\alpha se^* \rho sh,min^*fywe/fce+Min(\rho fx, \rho fy)$ = 0.05053697
    where $\rho f = \alpha f^* \rho f^*ffe/fce$ is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ρfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      ρfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
      $\varepsilon u,f$ = 0.015
      αse = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528

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 = 95733.333 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) = 1360.00
        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) = 1760.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 262500.00

    ----
        s = 100.00
      fywe = 555.55
      fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
        c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
      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 = 303.142
      with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
      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 = 303.142
      with Es2 = Es = 200000.00
  yv = 0.00126309
  shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
  suv = 0.00467518

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
  with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
 2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
 v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----

with full section properties:

  b = 250.00
  d = 707.00
  d' = 43.00
  ν = 0.00279133
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

     ωfx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

     ωfy = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432

     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
     fu,f = 840.00
     Ef = 82000.00
     εu,f = 0.015
     αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
      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 = 95733.333 is the unconfined core area which is equal to $\sum$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) = 1360.00
      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) = 1760.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 262500.00
    ----
     s = 100.00
     fywe = 555.55

```
    fce  = 20.00
  From ((5.A.5), TBDY), TBDY:  cc = 0.00271051
      c  = confinement factor = 1.07105
 y1 = 0.00126309
 sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
 y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
    with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
  v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c  = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
```

```
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =    su (4.1) = 9.0507052E-006
------------------------------------------------------------


Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Mu2+
---------------------------------------------------------------------


---------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
---------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027913
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ---------------------------------------------------------------
     fx = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432
    ---------------------------------------------------------------
     fy = 0.03840724
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.14946032
```

with Unconfined area = $((b_{max}-2R)^2+(h_{max}-2R)^2)/3$ = 0.00
    b_{max} = 750.00
    h_{max} = 550.00
    From EC8 A.4.4.3(6), $p_f = 2t_f/b_w$ = 0.008
      b_w = 250.00
    effective stress from (A.35), $f_{f,e}$ = 642.432

    R = 40.00
    Effective FRP thickness, $t_f = NL*t*Cos(b1)$ = 1.00
    $f_{u,f}$ = 840.00
    E_f = 82000.00
     u,f = 0.015
    a_{se} = Max((($A_{conf,max}-A_{noConf})/A_{conf,max})*($A_{conf,min}/A_{conf,max}$),0) = 0.35771528
      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.
      $A_{conf,max}$ = 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.
      $A_{conf,min}$ = 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 = 95733.333 is the unconfined core area which is equal to $b_{i}2/6$ as defined at (A.2).
    $p_{sh,min}$ = Min($p_{sh,x}$, $p_{sh,y}$) = 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)

    $p_{sh,x}$ ((5.4d), TBDY) = $L_{stir}*A_{stir}/(A_{sec}*s)$ = 0.00406911
      L_{stir} (Length of stirrups along Y) = 1360.00
      A_{stir} (stirrups area) = 78.53982
      A_{sec} (section area) = 262500.00

    $p_{sh,y}$ ((5.4d), TBDY) = $L_{stir}*A_{stir}/(A_{sec}*s)$ = 0.00526591
      L_{stir} (Length of stirrups along X) = 1760.00
      A_{stir} (stirrups area) = 78.53982
      A_{sec} (section area) = 262500.00
----
     s = 100.00
    f_{ywe} = 555.55
    f_{ce} = 20.00
  From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
fy1 = 303.142
 su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
  with Es1 = Es = 200000.00
  y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.28841607
  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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
 2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
 v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
   c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
  = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis

```
    s = 100.00
    n = 20.00
```


Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----
       fx = 0.03840724
     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 = 0.008
         bw = 250.00
       effective stress from (A.35), ff,e = 642.432
     ----
       fy = 0.03840724
     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 = 0.008
         bw = 250.00
       effective stress from (A.35), ff,e = 642.432

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
       fu,f = 840.00
       Ef = 82000.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
          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 = 95733.333 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) = 1360.00
               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) = 1760.00
               Astir (stirrups area) = 78.53982
               Asec (section area) = 262500.00
            ------------------------------------------------------------
               s = 100.00
            fywe = 555.55
            fce  = 20.00
        From ((5.A5), TBDY), TBDY:  cc = 0.00271051
            c = confinement factor = 1.07105
   y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
 fy1 = 303.142
  su1 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Es1 = Es = 200000.00
   y2 = 0.00126309
  sh2 = 0.00436529
 ft2 = 363.7704
 fy2 = 303.142
  su2 = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.28841607
     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 = 303.142
     with Es2 = Es = 200000.00
   yv = 0.00126309
  shv = 0.00436529
 ftv = 363.7704
 fyv = 303.142
  suv = 0.00467518
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
   2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
```

v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
      c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214

Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 0.61124127
     Vu = 7.6388586E-037
   d = 0.8*h = 600.00
   Nu = 9867.335
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
   where:
   Vs1 = 139624.944 is calculated for section web, with:

```
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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 = 1.00
  dfv = d (figure 11.2, ACI 440) = 707.00
  ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
    bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 614701.214
  knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
   = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 0.61124127
    Vu = 7.6388586E-037
  d = 0.8*h = 600.00
  Nu = 9867.335
  Ag = 187500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
  where:
  Vs1 = 139624.944 is calculated for section web, with:
    d = 200.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.50
  Vs2 = 418874.832 is calculated for section flange, with:
    d = 600.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.16666667
  Vf ((11-3)-(11.4), ACI 440) = 463792.00
    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, $tf1 = NL*t/NoDir = 1.00$
$dfv = d$ (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
        with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 445628.556
    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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -92158.008
Shear Force, V2 = 3917.97

Shear Force, V3 = -88.02562
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 2261.947
  -Compression: Asl,com = 829.3805
    -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R}$ = $*\theta_u$ = 0.04220387
$\theta_u = \theta_y + \theta_p$ = 0.0453805

- Calculation of θ_y -

θ_y = (My*Ls/3)/Eleff = 0.0033805 ((4.29),Biskinis Phd))
My = 3.4147E+008
Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1046.945
From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 3.5251E+013
  factor = 0.30
    Ag = 262500.00
    fc' = 20.00
    N = 10253.621
  Ec*Ig = 1.1750E+014

Calculation of Yielding Moment My

Calculation of θ_y and My according to Annex 7 -

θ_y = Min(θ_{y_ten}, θ_{y_com})
θ_{y_ten} = 4.8876648E-006
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
  d = 507.00
  ξy = 0.43218949
  A = 0.04093608
  B = 0.02750739
  with pt = 0.01784573
    pc = 0.00654344
    pv = 0.01625945
    N = 10253.621
    b = 250.00
    " = 0.08481262
θ_{y_comp} = 7.9066025E-006
with fc* (12.3, (ACI 440)) = 20.19686
  fc = 20.00
  fl = 0.70533557
  b = bmax = 750.00
  h = hmax = 550.00
  Ag = 262500.00
    ρg = pt + pc + pv = 0.04064862
  rc = 40.00
  Ae/Ac = 0.16554652
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  effective strain from (12.5) and (12.12), efe = 0.004
  fu = 0.009
  Ef = 82000.00
  Ec = 21019.039
  ξy = 0.43146506
  A = 0.04041476
  B = 0.02721993

with Es = 200000.00

Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.36052009

lb = 300.00

ld = 832.1312

Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

   = 1

  db = 18.00

  Mean strength value of all re-bars: fy = 444.44

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

    t = 1.00

    s = 0.80

    e = 1.00

  cb = 25.00

  Ktr = 3.14159

   Atr = Min(Atr_x,Atr_y) = 157.0796

   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis

    s = 100.00

    n = 20.00

 - 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 = 0.66355027

  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 = 10253.621

   Ag = 262500.00

   f'cE = 20.00

   fytE = fylE = 0.00

pl = Area_Tot_Long_Rein/(b*d) = 0.04064862

  b = 250.00

  d = 507.00

   f'cE = 20.00

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

At local axis: 2

Integration Section: (b)

Calculation No. 15

column C1, Floor 1

Limit State: 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,   = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Secondary Member: Steel Strength, fs = fs_lower_bound = 400.00
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
Existing material: Concrete Strength, fc = fcm = 20.00
Existing material: Steel Strength, fs = fsm = 444.44
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00

Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -171322.016
Shear Force, Va = 88.02562
EDGE -B-
Bending Moment, Mb = -92158.008
Shear Force, Vb = -88.02562
BOTH EDGES
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2261.947
      -Compression: Asl,com = 829.3805
          -Middle: Asl,mid = 2060.885
Mean Diameter of Tension Reinforcement, DbL,ten = 17.77778

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 359104.00
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 386133.333
   VCol = 386133.333
   knl = 1.00
      displacement_ductility_demand = 1.5858281E-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' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.37942
     Mu = 92158.008
     Vu = 88.02562
  d = 0.8*h = 440.00
  Nu = 10253.621
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 402123.86
  where:
  Vs1 = 276460.154 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 125663.706 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633
    fy = 400.00
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 332592.00
    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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
   Ef = 82000.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.009
  From (11-11), ACI 440: Vs + Vf <= 292293.685
    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 = 5.3608991E-009
 y = (My*Ls/3)/EIeff = 0.0033805 ((4.29),Biskinis Phd))
 My = 3.4147E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1046.945
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.5251E+013
    factor = 0.30
      Ag = 262500.00
      fc' = 20.00
      N = 10253.621
    Ec*Ig = 1.1750E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
 y = Min(y_ten, y_com)
 y_ten = 4.8876648E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
    d = 507.00
     y = 0.43218949
    A = 0.04093608
    B = 0.02750739
    with pt = 0.01784573
      pc = 0.00654344
      pv = 0.01625945
      N = 10253.621
      b = 250.00
       " = 0.08481262
 y_comp = 7.9066025E-006
 with fc* (12.3, (ACI 440)) = 20.19686
    fc = 20.00
    fl = 0.70533557
    b = bmax = 750.00
    h = hmax = 550.00
    Ag = 262500.00
       g = pt + pc + pv = 0.04064862
    rc = 40.00
    Ae/Ac = 0.16554652
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.009
   Ef = 82000.00
   Ec = 21019.039

```
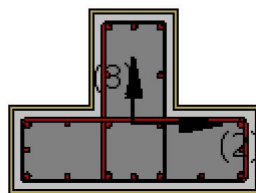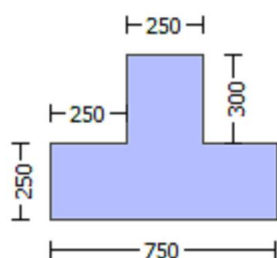      y = 0.43146506
    A = 0.04041476
    B = 0.02721993
     with Es = 200000.00
----------------------------------------------------------
----------------------------------------------------------

Calculation of ratio lb/ld
----------------------------------------------------------
Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 444.44
  fc' = 20.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00
----------------------------------------------------------
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 1.2475615E-020
EDGE -B-

Shear Force, Vb = -1.2475615E-020
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.66355027
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 299460.205
with
Mpr1 = Max(Mu1+ , Mu1-) = 4.4919E+008
  Mu1+ = 4.4919E+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- = 2.2828E+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-) = 4.4919E+008
  Mu2+ = 4.4919E+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- = 2.2828E+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 = 1.5419151E-005
Mu = 4.4919E+008
----
with full section properties:
 b = 250.00
 d = 507.00
 d' = 43.00
 v = 0.00389244
  N = 9867.335
 fc = 20.00
  co (5A.5, TBDY) = 0.002
 Final value of　cu:　cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY:　cu = 0.01249217
    we ((5.4c), TBDY) = ase*　sh,min*fywe/fce+Min(　fx,　fy) = 0.05053697
   where　f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
    fx = 0.03840724
   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 = 0.008
     bw = 250.00
    effective stress from (A.35), ff,e = 642.432
    ----
    fy = 0.03840724
   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 = 0.008
   bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
   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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00

----

s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142
    with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
    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 = 303.142
   with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
  v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
 b = 190.00
 d = 477.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
  v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
 u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
  b = 750.00
  d = 507.00
  d' = 43.00
  v = 0.00129748
    N = 9867.335
  fc = 20.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01249217
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432

      ωfy = 0.03840724
    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 = 0.008
          bw = 250.00
       effective stress from (A.35), ff,e = 642.432

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
      fu,f = 840.00
      Ef = 82000.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
        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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:

```
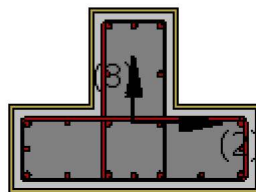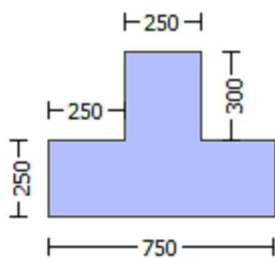    b = 690.00
    d = 477.00
    d' = 13.00
    fcc (5A.2, TBDY) = 21.42102
      cc (5A.5, TBDY) = 0.00271051
        c  = confinement factor = 1.07105
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
      2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
      v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
  u =   su (4.1) = 1.1097366E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
     = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
----------------------------------------------------------------------------
----------------------------------------------------------------------------
----------------------------------------------------------------------------
Calculation of Mu2+
----------------------------------------------------------------------------

----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.5419151E-005
Mu = 4.4919E+008
----------------------------------------------------------------------------
with full section properties:
  b = 250.00
  d = 507.00
  d' = 43.00
  v = 0.00389244
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01249217
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      fx = 0.03840724
    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 = 0.008
       bw = 250.00
    effective stress from (A.35), ff,e = 642.432
    ----
    fy = 0.03840724
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 = 0.008
       bw = 250.00
    effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
    u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
       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 = 95733.333 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) = 1360.00
       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) = 1760.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 262500.00
    ----
    s = 100.00
    fywe = 555.55
    fce = 20.00
    From ((5.A5), TBDY), TBDY: cc = 0.00271051
       c = confinement factor = 1.07105
  y1 = 0.00126309
  sh1 = 0.00436529
 ft1 = 363.7704
fy1 = 303.142
  su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
    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 = 303.142

with Es1 = Es = 200000.00
    y2 = 0.00126309
    sh2 = 0.00436529
   ft2 = 363.7704
   fy2 = 303.142
    su2 = 0.00467518
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 0.28841607
        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 = 303.142
        with Es2 = Es = 200000.00
    yv = 0.00126309
    shv = 0.00436529
   ftv = 363.7704
   fyv = 303.142
    suv = 0.00467518
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.28841607
        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 = 303.142
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.27048958
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09917951
    v = Asl,mid/(b*d)*(fsv/fc) = 0.24644606
and confined core properties:
   b = 190.00
   d = 477.00
   d' = 13.00
   fcc (5A.2, TBDY) = 21.42102
    cc (5A.5, TBDY) = 0.00271051
       c = confinement factor = 1.07105
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.37829146
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13870687
     v = Asl,mid/(b*d)*(fsv/fc) = 0.34466555
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.40196077
Mu = MRc (4.15) = 4.4919E+008
  u =   su (4.1) = 1.5419151E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
   db = 18.00

Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  t = 1.00
  s = 0.80
  e = 1.00
cb = 25.00
Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.1097366E-005
Mu = 2.2828E+008
----
with full section properties:
 b = 750.00
 d = 507.00
 d' = 43.00
 v = 0.00129748
  N = 9867.335
 fc = 20.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: εcu = 0.01249217
   ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697
  where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

   ωfx = 0.03840724
  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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   ωfy = 0.03840724
  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 = 0.008
    bw = 250.00
   effective stress from (A.35), ff,e = 642.432

   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
   fu,f = 840.00
   Ef = 82000.00
   εu,f = 0.015
   αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
   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) = 1760.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 262500.00
----
   s = 100.00
   fywe = 555.55
   fce = 20.00
From ((5.A5), TBDY, TBDY: cc = 0.00271051
   c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
   with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03305984
2 = Asl,com/(b*d)*(fs2/fc) = 0.09016319
v = Asl,mid/(b*d)*(fsv/fc) = 0.08214869
and confined core properties:
b = 690.00
d = 477.00
d' = 13.00
fcc (5A.2, TBDY) = 21.42102
cc (5A.5, TBDY) = 0.00271051
c = confinement factor = 1.07105
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03819464
2 = Asl,com/(b*d)*(fs2/fc) = 0.10416721
v = Asl,mid/(b*d)*(fsv/fc) = 0.0949079
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.16905899
Mu = MRc (4.14) = 2.2828E+008
u = su (4.1) = 1.1097366E-005

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 = 1
db = 18.00
Mean strength value of all re-bars: fy = 555.55
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 3.14159
Atr = Min(Atr_x,Atr_y) = 157.0796
where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
s = 100.00
n = 20.00

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 451299.955

Calculation of Shear Strength at edge 1, Vr1 = 451299.955
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
VCol0 = 451299.955
knl = 1 (zero step-static loading)

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

 = 1 (normal-weight concrete)
fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 2.00
Mu = 1106.371

Vu = 1.2475615E-020
d = 0.8*h = 440.00
Nu = 9867.335
Ag = 137500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
where:
Vs1 = 307174.877 is calculated for section web, with:
  d = 440.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.22727273
Vs2 = 139624.944 is calculated for section flange, with:
  d = 200.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 332592.00
  ψ_f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin β + cos β is replaced with (cot θ +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(α, θ), 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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
    Ef = 82000.00
    ϵfe = 0.004, from (11.6a), ACI 440
      with ϵfu = 0.009
From (11-11), ACI 440: Vs + Vf <= 326794.274
    bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 451299.955
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 451299.955
  knl = 1 (zero step-static loading)

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

    λ = 1 (normal-weight concrete)
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
    Mu = 1106.371
    Vu = 1.2475615E-020
  d = 0.8*h = 440.00
  Nu = 9867.335
  Ag = 137500.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 446799.82
  where:
  Vs1 = 307174.877 is calculated for section web, with:
    d = 440.00
    Av = 157079.633
    fy = 444.44
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.22727273
  Vs2 = 139624.944 is calculated for section flange, with:
    d = 200.00
    Av = 157079.633

fy = 444.44
s = 100.00
Vs2 is multiplied by   Col2 = 1.00
s/d = 0.50
Vf ((11-3)-(11.4), ACI 440) = 332592.00
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 = 1.00
dfv = d (figure 11.2, ACI 440) = 507.00
ffe ((11-5), ACI 440) = 328.00
Ef = 82000.00
fe = 0.004, from (11.6a), ACI 440
with fu = 0.009
From (11-11), ACI 440: Vs + Vf < = 326794.274
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,   = 0.93
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 555.55
##
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.07105
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lo = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00

Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = -7.6388586E-037
EDGE -B-
Shear Force, Vb = 7.6388586E-037
BOTH EDGES
Axial Force, F = -9867.335
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 = 0.56949066
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 350066.602
with
Mpr1 = Max(Mu1+ , Mu1-) = 5.2510E+008
   Mu1+ = 5.2510E+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- = 5.2510E+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-) = 5.2510E+008
   Mu2+ = 5.2510E+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- = 5.2510E+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 = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.0027933
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01249217
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05053697
     where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----
       fx = 0.03840724

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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432
----
  fy = 0.03840724
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 = 0.008
     bw = 250.00
   effective stress from (A.35), ff,e = 642.432

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
  fu,f = 840.00
  Ef = 82000.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
   s = 100.00
  fywe = 555.55
  fce = 20.00
From ((5.A5), TBDY): cc = 0.00271051
  c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
  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 = 303.142
 with Es1 = Es = 200000.00
 y2 = 0.00126309
 sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
 su2 = 0.00467518
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/lb,min = 0.28841607
 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 = 303.142
 with Es2 = Es = 200000.00
 yv = 0.00126309
 shv = 0.00436529
ftv = 363.7704
fyv = 303.142
 suv = 0.00467518
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.28841607
 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 = 303.142
 with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
 2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
 v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
 cc (5A.5, TBDY) = 0.00271051
  c = confinement factor = 1.07105
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
 2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
 v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164

Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

    ψ = 1

  db = 18.00

  Mean strength value of all re-bars: fy = 555.55

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

    ψt = 1.00

    ψs = 0.80

    ψe = 1.00

  cb = 25.00

  Ktr = 3.14159

   Atr = Min(Atr_x,Atr_y) = 157.0796

   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis

   s = 100.00

   n = 20.00

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:

  φu = 9.0507052E-006

Mu = 5.2510E+008

----

with full section properties:

  b = 250.00

  d = 707.00

  d' = 43.00

  v = 0.00279133

    N = 9867.335

  fc = 20.00

  εco (5A.5, TBDY) = 0.002

  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01249217

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

    From (5.4b), TBDY: εcu = 0.01249217

      ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05053697

    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

     ωfx = 0.03840724

    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 = 0.008

        bw = 250.00

      effective stress from (A.35), ff,e = 642.432

     ωfy = 0.03840724

    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 = 0.008

        bw = 250.00

      effective stress from (A.35), ff,e = 642.432

     R = 40.00

     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00

     fu,f = 840.00

     Ef = 82000.00

     εu,f = 0.015

     αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528

      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 = 95733.333 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) = 1360.00
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) = 1760.00
Astir (stirrups area) = 78.53982
Asec (section area) = 262500.00

----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.28841607
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 = 303.142
with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.28841607
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 = 303.142
with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.28841607
     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 = 303.142
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
    v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
  b = 190.00
  d = 677.00
  d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
     c = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
   s = 100.00
   n = 20.00

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00

d = 707.00
d' = 43.00
ν = 0.00279133
  N = 9867.335
fc = 20.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01249217
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+ Min(fx,   fy) = 0.05053697
   where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
    fx = 0.03840724
   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 = 0.008
       bw = 250.00
     effective stress from (A.35), ff,e = 642.432
   ----
    fy = 0.03840724
   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 = 0.008
       bw = 250.00
     effective stress from (A.35), ff,e = 642.432

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
    fu,f = 840.00
    Ef = 82000.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
       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 = 95733.333 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) = 1360.00
       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) = 1760.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 262500.00
   ----
      s = 100.00
     fywe = 555.55
     fce = 20.00
   From ((5.A5), TBDY), TBDY: cc = 0.00271051

```
        c  = confinement factor = 1.07105
    y1 = 0.00126309
   sh1 = 0.00436529
  ft1 = 363.7704
  fy1 = 303.142
   su1 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Es1 = Es = 200000.00
    y2 = 0.00126309
   sh2 = 0.00436529
  ft2 = 363.7704
  fy2 = 303.142
   su2 = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.28841607
       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 = 303.142
       with Es2 = Es = 200000.00
    yv = 0.00126309
   shv = 0.00436529
  ftv = 363.7704
  fyv = 303.142
   suv = 0.00467518
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.28841607
       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 = 303.142
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
    2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
    v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
   b = 190.00
   d = 677.00
   d' = 13.00
  fcc (5A.2, TBDY) = 21.42102
   cc (5A.5, TBDY) = 0.00271051
       c  = confinement factor = 1.07105
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
    2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
    v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
```

--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
  u =   su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
  db = 18.00
  Mean strength value of all re-bars: fy = 555.55
  fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    t = 1.00
    s = 0.80
    e = 1.00
  cb = 25.00
  Ktr = 3.14159
   Atr = Min(Atr_x,Atr_y) = 157.0796
   where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 9.0507052E-006
Mu = 5.2510E+008
----
with full section properties:
  b = 250.00
  d = 707.00
  d' = 43.00
  v = 0.00279133
    N = 9867.335
  fc = 20.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01249217
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01249217
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05053697
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.03840724
    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 = 0.008
        bw = 250.00
      effective stress from (A.35), ff,e = 642.432
    ----
      fy = 0.03840724
    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 = 0.008
    bw = 250.00
effective stress from (A.35), ff,e = 642.432

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.00
fu,f = 840.00
Ef = 82000.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.35771528
    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 = 95733.333 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) = 1360.00
    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) = 1760.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 262500.00
----
s = 100.00
fywe = 555.55
fce = 20.00
From ((5.A5), TBDY), TBDY: cc = 0.00271051
    c = confinement factor = 1.07105
y1 = 0.00126309
sh1 = 0.00436529
ft1 = 363.7704
fy1 = 303.142
su1 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
   with Es1 = Es = 200000.00
y2 = 0.00126309
sh2 = 0.00436529
ft2 = 363.7704
fy2 = 303.142
su2 = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.28841607
   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 = 303.142
  with Es2 = Es = 200000.00
yv = 0.00126309
shv = 0.00436529
ftv = 363.7704
fyv = 303.142
suv = 0.00467518
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.28841607
   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 = 303.142
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.10560699
  2 = Asl,com/(b*d)*(fs2/fc) = 0.10560699
  v = Asl,mid/(b*d)*(fsv/fc) = 0.23061118
and confined core properties:
 b = 190.00
 d = 677.00
 d' = 13.00
 fcc (5A.2, TBDY) = 21.42102
  cc (5A.5, TBDY) = 0.00271051
    c = confinement factor = 1.07105
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.14511417
  2 = Asl,com/(b*d)*(fs2/fc) = 0.14511417
  v = Asl,mid/(b*d)*(fsv/fc) = 0.31688196
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.26937211
Mu = MRc (4.15) = 5.2510E+008
 u = su (4.1) = 9.0507052E-006

Calculation of ratio lb/ld

Lap Length: lb/ld = 0.28841607
lb = 300.00
ld = 1040.164
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
    = 1
 db = 18.00
 Mean strength value of all re-bars: fy = 555.55
 fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   t = 1.00
   s = 0.80
   e = 1.00
 cb = 25.00
 Ktr = 3.14159
  Atr = Min(Atr_x,Atr_y) = 157.0796
  where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
  s = 100.00
  n = 20.00

```
--------------------------------------------------------------------
--------------------------------------------------------------------
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--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 614701.214
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 614701.214
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 614701.214
   knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
      = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 2.00
      Mu = 0.61124127
      Vu = 7.6388586E-037
   d = 0.8*h = 600.00
   Nu = 9867.335
   Ag = 187500.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
   where:
   Vs1 = 139624.944 is calculated for section web, with:
      d = 200.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.50
   Vs2 = 418874.832 is calculated for section flange, with:
      d = 600.00
      Av = 157079.633
      fy = 444.44
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.16666667
   Vf ((11-3)-(11.4), ACI 440) = 463792.00
      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 = 1.00
   dfv = d (figure 11.2, ACI 440) = 707.00
   ffe ((11-5), ACI 440) = 328.00
      Ef = 82000.00
       fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.009
   From (11-11), ACI 440: Vs + Vf <= 445628.556
      bw = 250.00
--------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 614701.214
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 614701.214
   knl = 1 (zero step-static loading)
--------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
--------------------------------------------------------------
      = 1 (normal-weight concrete)
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
```

M/Vd = 2.00
   Mu = 0.61124127
   Vu = 7.6388586E-037
d = 0.8*h = 600.00
Nu = 9867.335
Ag = 187500.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558499.776
where:
Vs1 = 139624.944 is calculated for section web, with:
  d = 200.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.50
Vs2 = 418874.832 is calculated for section flange, with:
  d = 600.00
  Av = 157079.633
  fy = 444.44
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.16666667
Vf ((11-3)-(11.4), ACI 440) = 463792.00
  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 = 1.00
dfv = d (figure 11.2, ACI 440) = 707.00
ffe ((11-5), ACI 440) = 328.00
  Ef = 82000.00
  fe = 0.004, from (11.6a), ACI 440
   with fu = 0.009
From (11-11), ACI 440: Vs + Vf <= 445628.556
  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, = 0.93
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:
Existing material of Secondary Member: Concrete Strength, fc = fcm = 20.00
Existing material of Secondary Member: Steel Strength, fs = fsm = 444.44
Concrete Elasticity, Ec = 21019.039
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 550.00
Min Height, Hmin = 250.00
Max Width, Wmax = 750.00
Min Width, Wmin = 250.00
Eccentricity, Ecc = 250.00

Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Lap Length lb = 300.00
FRP Wrapping Data
Type: Carbon
Dry properties (design values)
Thickness, t = 1.00
Tensile Strength, ffu = 840.00
Tensile Modulus, Ef = 82000.00
Elongation, efu = 0.009
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 = 107137.548
Shear Force, V2 = 3917.97
Shear Force, V3 = -88.02562
Axial Force, F = -10253.621
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
      -Compression: Aslc = 5152.212
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 1231.504
      -Compression: Asl,com = 1231.504
        -Middle: Asl,mid = 2689.203
Mean Diameter of Tension Reinforcement, DbL = 17.60

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.03962398
 θu = θy + θp = 0.04260643

 - Calculation of θy -

 θy = (My*Ls/3)/Eleff = 0.00060643 ((4.29),Biskinis Phd))
  My = 3.5103E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 300.00
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 5.7884E+013
     factor = 0.30
        Ag = 262500.00
        fc' = 20.00
        N = 10253.621
     Ec*Ig = 1.9295E+014

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7   -

  θy = Min(θy_ten, θy_com)
  θy_ten = 2.9883067E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 281.4121
     d = 707.00
      y = 0.33400922
     A = 0.02935586

```
      B = 0.01566745
        with pt = 0.00696749
            pc = 0.00696749
            pv = 0.01521473
            N = 10253.621
            b = 250.00
             " = 0.06082037
    y_comp = 7.3565275E-006
  with fc* (12.3, (ACI 440)) = 20.20861
       fc = 20.00
       fl = 0.70533557
       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) = 1.00
       effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.009
       Ef = 82000.00
      Ec = 21019.039
       y = 0.33273912
       A = 0.02898211
       B = 0.01546131
        with Es = 200000.00
```


Calculation of ratio lb/ld

Lap Length: ld/ld,min = 0.36052009
lb = 300.00
ld = 832.1312
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
```
     = 1
   db = 18.00
   Mean strength value of all re-bars: fy = 444.44
   fc' = 20.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     t = 1.00
     s = 0.80
     e = 1.00
   cb = 25.00
   Ktr = 3.14159
    Atr = Min(Atr_x,Atr_y) = 157.0796
    where Atr_x, Atr_y are the sum of the area of all stirrup legs along X and Y loxal axis
    s = 100.00
    n = 20.00
```

 - 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 = 0.56949066
   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 = 10253.621
    Ag = 262500.00
    f'cE = 20.00

fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.02914971
   b = 250.00
   d = 707.00
    f'cE = 20.00

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